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TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS
WITH PARTS LIST
ORGANIZATIONAL MAINTENANCE LEVEL

FREQUENCY-TIME STANDARD AN/URQ-23
PART NO. 11500-2800

FREQUENCY ELECTRONICS, INC.

N00039-78-C-0328

PUBLISHED BY DIRECTION OF
COMMANDER, NAVAL ELECTRONIC SYSTEMS

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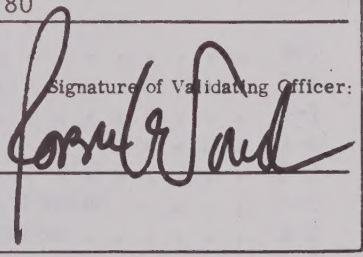

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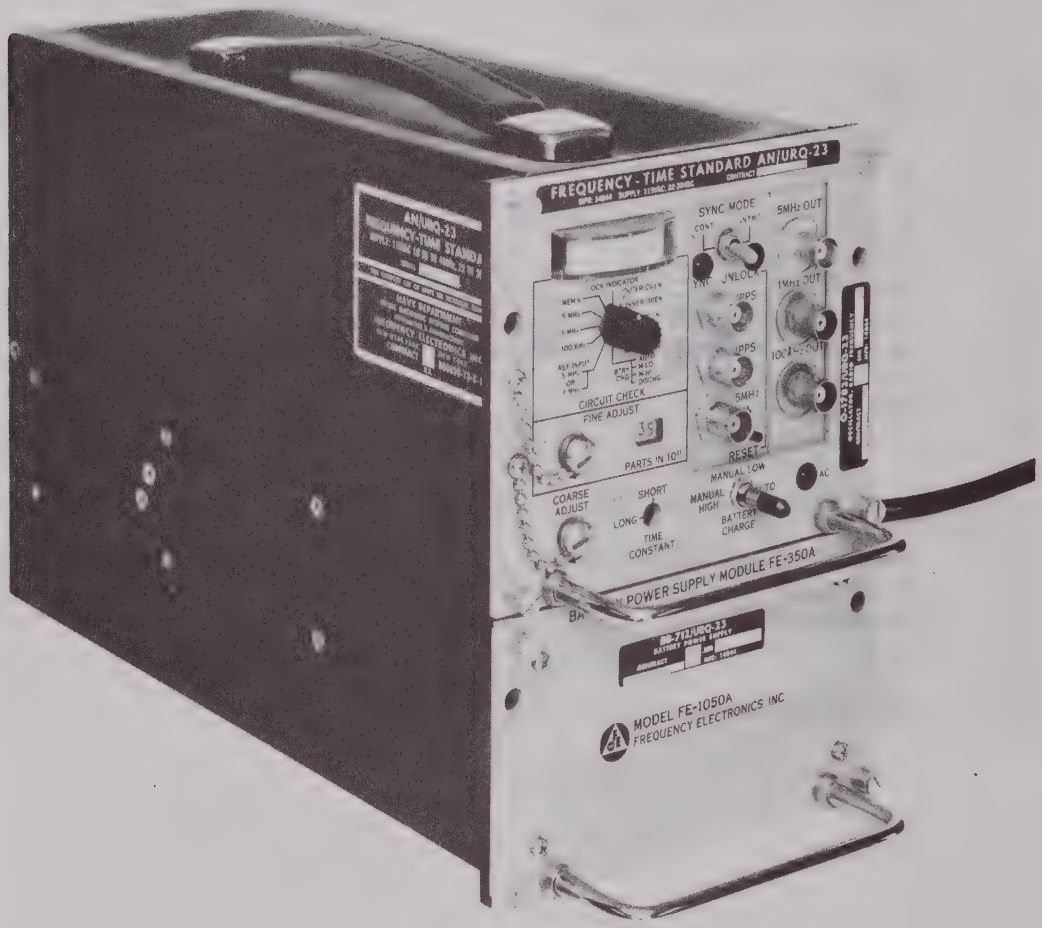


Figure 1-1. Frequency-Time Standard AN/URQ-23

CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

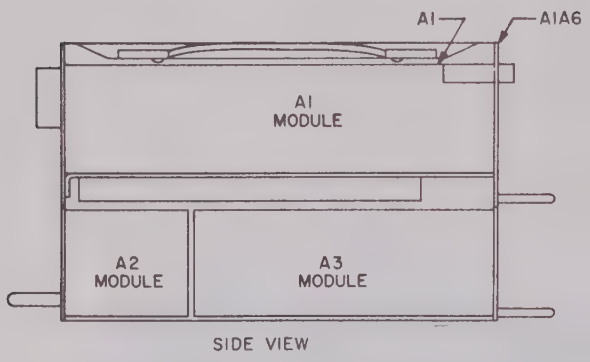
1-1. SAFETY PRECAUTIONS. No special safety precautions for the protection of personnel or the ship are required when operating or maintaining the Standard. Forces afloat comply with OPNAVINST 5100 series; and shore activities comply with NAVMAT P-5100 series.

1-2. INTRODUCTION. This technical manual describes Frequency-Time Standard AN/URQ-23, manufactured by Frequency Electronics, Inc., New Hyde Park, New York. Instructions and data are included for installation, operation, troubleshooting, and maintenance. In addition, a parts list is provided for the equipment and its major assemblies. This technical manual is in effect upon receipt.

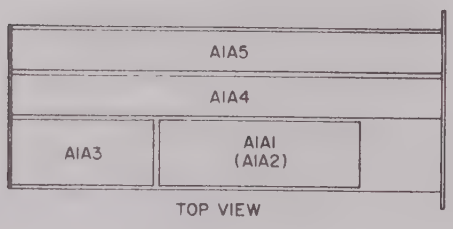
1-3. EQUIPMENT DESCRIPTION. The following subparagraphs describe the purpose and use of the equipment and the physical arrangement of its major assemblies.

a. Purpose and Use. Frequency-Time Standard AN/URQ-23 (hereinafter referred to as the standard) is a compact, precise and stable frequency standard that provides accurate 5 megahertz (MHZ), 1 MHZ, 100 kilowatts (KW), megapulse-per-second (MPPS) and 1 pulse-per-second (PPS) outputs. The standard can be used in landbased and shipboard applications. The standard can be used as a stand alone unit or as an integrated component equipment supporting satellite communication systems, navigation systems, timing and frequency controls, and for calibration of other instruments. The standard's internal, quartz, 5 MHz, voltage controlled oscillator (VCO) can be phase-locked to an external 5MHz or 1MHz reference input. In this phase- locked condition, VCO locking information is stored by means of built-in analog- to-digital (A/D), digital-to-analog (D/A) converters. Loss of the reference input signal will cause the A/D, D/A converters to maintain the last VCO locking information in storage thereby preventing any large frequency or phase perturbations on the standard's output signals. This will allow the standard to transition smoothly from the phase-locked, long-term stability of the higher order external reference input to its own, inherent, free-running longterm stability specified in table 1-3. Another important feature of the standard is that the 1 PPS time base output, which is directly divided from the internal 5MHz VCO, can also be synchronized to an external 1 PPS signal. The standard can therefore operate in the following modes: (1) totally phase-locked and synchronized to a known, higher order external reference source and (2) free-running on its own internal, 5 MHz VCO with no external reference signal input. The standard can be operated from external alternating current (ac) or direct current (dc) power sources or from an internal battery supply. With external ac and dc both applied, ac is the primary power source with an automatic switch to dc if the ac fails. When ac fails, an alarm is generated in the form of a relay contact transfer at connector A1A3J1. If both external ac and dc sources fail, the standard operates on an internal battery for a minimum of 7 hours.

SIMPLIFIED MODULE LOCATION DIAGRAM



A1 RF OSCILLATOR MODULE (Top View)
ASSEMBLY LOCATION DIAGRAM



A1A1 - 5MHz Oscillator Assembly
A1A2 - Loop Filter/Oscillator Tuning Assembly (Beneath A1A1)
A1A3 - Power Converter Assembly
A1A4 - 1 PPS Generator and Frequency Control Assembly
A1A5 - Buffer/Divider Assembly
A1A6 - Front Panel Assembly

A1 RF Oscillator Module, FE-150A
A2 Power Supply Module, FE-250A
A3 Battery Power Supply Module, FE-350A

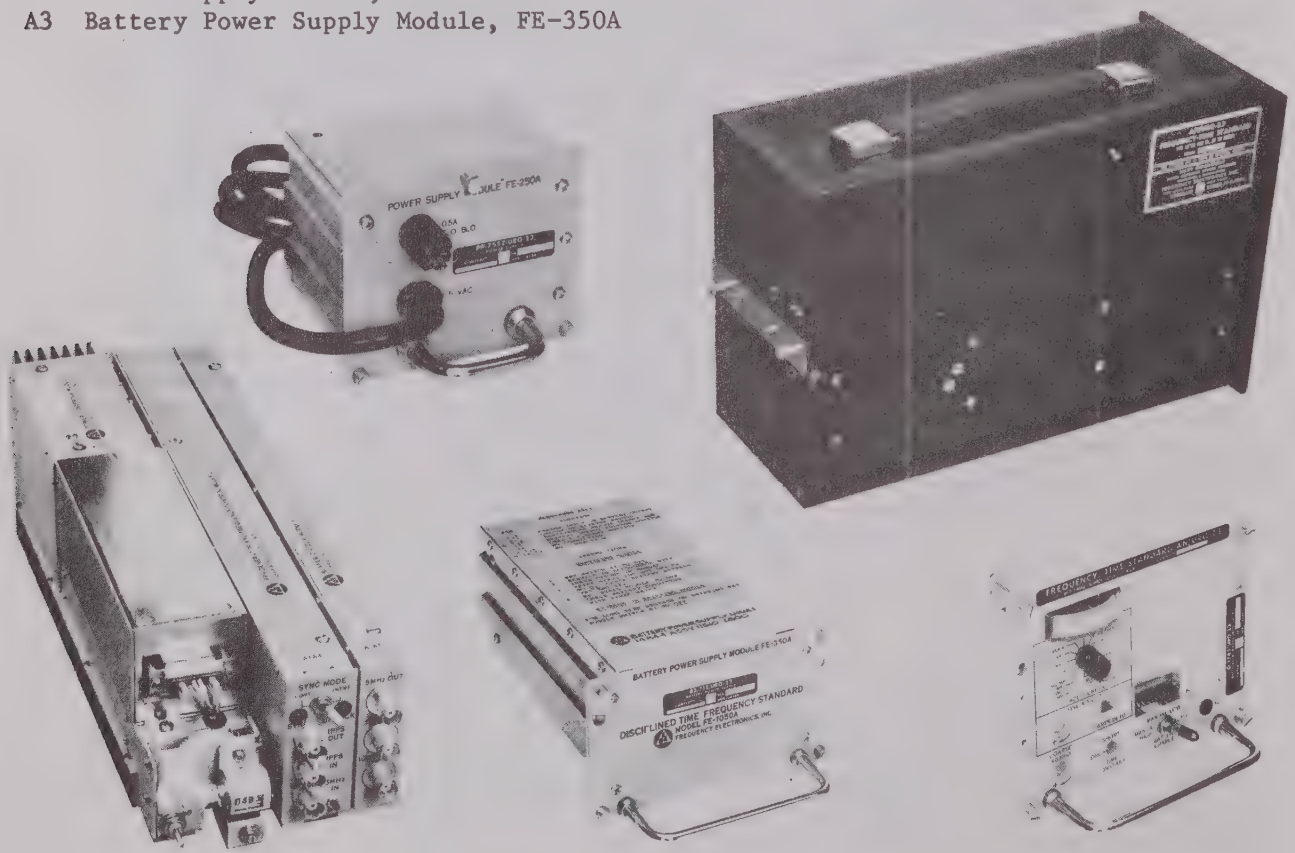


Figure 1-2. Major Assemblies of Standard Modules

Table 1-1. List of Modules, Assemblies, and Subassemblies

Reference Designation	Military Nomenclature	Common Name
A1	Radio Frequency Oscillator O-1783/URQ-23	Rf Oscillator
A1A1	-	5MHz oscillator
A1A1A1	-	5MHz oscillator and amplifier
A1A1A2	-	Inner oven control
A1A1A3	-	Outer oven control
A1A2	-	Loop filter/oscillator tuning
A1A2A1	-	Loop filter
A1A3	-	Power converter
A1A3A1	-	Dc-dc convertr
A1A3A2	-	Switching regulator
A1A3A3	-	Linear regulators (4)
A1A4	-	1 PPS generator and frequency control
A1A4A1	-	1 PPS generator
A1A4A2	-	Frequency control
A1A4A3	-	Analog voltage storage
A1A5	-	Buffer/divider
A1A5A1	-	100 KHz buffer/divider
A1A5A2	-	1MHz buffer/divider
A1A5A3	-	5MHz buffer/crystal filter
A1A6	-	Front panel
A1A6A1	-	Circuit check
A2	Power Supply PP-7557/URQ-23	Power supply
A2A1	-	Battery charger
A3	Battery Power Supply BB-712/URQ-23	Battery power supply
A3A1	-	Battery low voltage disconnect relay and fuses

b. Physical Description. Three major plug-in modules mounted in an enclosure comprise the standard. These modules, Radio Frequency Oscillator O-1783/URQ-23, Power Supply PP-7557/URQ-23 and Battery Power Supply BB-712/URQ-23, are shown in figure 1-2. Physical descriptions of each of these modules are provided in the following subparagraphs.

(1) Radio Frequency Oscillator O-1783/URQ-23. Radio Frequency Oscillator O-1783/URQ-23 (hereinafter called rf oscillator A1) contains most of the electronic circuits of the standard. These circuits are arranged on six assemblies, which are listed in table 1-1 and illustrated in figure 1-2. The six assemblies are interconnected on a chassis through respective connectors. The output signals of each assembly that are required by the user are directly accessible at the front or on the rear of the standard. In addition, all operating controls and indicators for the standard (except one located on Battery Power Supply BB-712/URQ-23) are accessible on the front and rear panels. (See figures 2-1, 2-2 and 2-3.) Access to the assemblies (other than front panel A1A6) requires removal of the standard's enclosure. (See figure 1-2.) Rf oscillator A1 is secured to the enclosure of the standard by two captive fasteners at the rear of the enclosure and by four captive fasteners that secure front panel A1A6 at the front of the standard.

(2) Power Supply PP-7557/URQ-23. Power Supply PP-7557/URQ-23 (hereinafter called power supply A2) contains a transformer, a bridge rectifier and two filter capacitors that convert incoming 115 volt ac power to +22 volts dc for use in the A1 module. The module also contains one assembly, plug-in printed circuit board (A2A1). The A2A1 assembly contains circuits that charge a battery pack inside Battery Power Supply BB-712/URQ-23. Power Supply A2 is secured to the enclosure of the standard by three captive fasteners. A protective fuse holder and an ac line cord are located at the rear panel of this module. (See figure 2-2.)

(3) Battery Power Supply BB-712/URQ-23. Battery Power Supply BB-712/URQ-23 (hereinafter called battery power supply A3) contains a nickel-cadmium (NiCad) storage battery pack that serves as the source of emergency power for the standard, if external power sources fail or are otherwise temporarily unavailable. The battery power supply is capable of operating the standard for 7 hours at ambient temperature when the batteries are fully charged. In addition to the battery pack, battery power supply A3 houses an assembly (A3A1) that contains protective circuits and fuses for the battery. These circuits automatically disconnect the battery from the load in the standard, if the battery voltage is below 10 volts. A switch on the rear of battery power supply A3 (figure 2-3) provides a means of disconnecting battery power manually. Battery power supply A3 is secured to the enclosure of the standard by four captive fasteners.

1-4. RELATIONSHIP OF UNITS. The standard is a self-contained unit. Its three plug-in modules, described in paragraph 1-3, slide into mounting spaces in a black aluminum enclosure. Major plug-in assemblies in the modules are retained in position by knurled head captive fasteners. Electrical connector receptacles are keyed and staggered to prevent insertion of a module assembly in the incorrect slot. Power supply A2 and battery power supply A3 are furnished with handles to provide ease of handling. The standard will operate properly with either power supply A2 or battery power supply A3 withdrawn from the enclosure. If external dc power is connected to external dc input connector A1A3J1 (figure 2-2), however, operation can proceed with both assemblies removed.

Table 1-2. Functional Characteristics

Function	Characteristics
Power:	
External ac input power	115 volts (103.5 volts to 126.5 volts) 50 Hz ±5%, 60Hz ± 5%, 400 Hz ± 10% 30 Watts, maximum power consumption
External dc input power	+22 to +30 volts at 1.0 amperes, maximum 26W cold start, 12W operate
Internal battery	+12 volts for 7 hours at 22°C +2°C, -0°C
Output Frequencies:	
Analog (sine and square waves)	5 MHz and 1 MHz sine wave, 100 KHz square wave
Digital (timing pulse)	1 PPS and 1 MPPS
Input Reference signals:	
Phase lock frequencies	5 MHz sine wave, 1 MHz sine wave
Frequency synchronization signals	1 PPS pulse, 1 MHz sine wave + 1 PPS, or 1 MHz square wave + 1 PPS (+ = algebraic addition)
Output Alarm Signal	Relay contact transfer
Physical Characteristics	
Height	7-3/4 inches
Width	5-1/2 inches
Depth	12 inches (15-15/16 inches with protrusions)
Weight	23 pounds, maximum

1-5. REFERENCE DATA. Reference data for the standard is described in the following subparagraphs.

a. Descriptive Data. Military nomenclature for the overall standard is: Frequency-Time Standard AN/URQ-23. It is manufactured by Frequency Electronics, Inc. of New Hyde Park, New York and is equivalent to that manufacturer's Model FE-1050A. The standard consists of the modules, assemblies, and subassemblies listed in table 1-1.

b. Functional Characteristics. The functional characteristics of the standard are summarized in table 1-2.

c. Capabilities and Limitations. The capabilities and limitations of the standard are listed in table 1-3.

d. Rated Outputs. The rated values for the output signals of the standard are listed in table 1-4.

e. Environmental Characteristics. The environmental operating conditions for the standard are listed in table 1-5.

1-6. EQUIPMENT, ACCESSORIES, AND DOCUMENTS SUPPLIED. The equipment and documents supplied with the standard are listed in table 1-6 with their crated and uncrated dimensions, weight, and volume.

1-7. EQUIPMENT AND PUBLICATIONS REQUIRED, BUT NOT SUPPLIED. The equipment required to operate and service the standard, but which is not supplied with the standard is listed in table 1-7. All required documentation is supplied with the standard.

1-8. FACTORY OR FIELD CHANGES. No factory or field changes have been made to the standard as of the date of this publication. Entries shall be made in table 1-8 as changes are incorporated in the equipment. Specify in the description column whether the change is made in the field or factory.

Table 1-3. Capabilities and Limitations

Characteristic	Capabilities and Limitations
Frequency Aging:	
After turn-on	After / Next No. of days / Aging Rate 1 day / 3 / 3.3 parts per 10^{10}/day 4 days / 7 / 2.1 parts per 10^{10}/day 11 days / 60 / 0.66 parts per 10^{10}/day
Short-term	Time / Accuracy 100 milliseconds / 6 parts per 10^{12} 1 second / 2 parts per 10^{12} 10 seconds / 2 parts per 10^{12} 100 seconds / 3 parts per 10^{12}
Stability:	
0° C to 50° C	Not greater than 5 parts per 10^{10}
115 volts ac ±10% or +22 to +30 volts dc	Not greater than 5 parts per 10^{10}
Open load to 50 ohms resistive or reactive load	2 parts per 10^{11} on 5 MHz and 1 MHz outputs
Frequency Adjustment:	
Fine Adjust	999 parts in 10^{11} (in 1 part in 10^{11} steps)
Coarse Adjust	Not less than 1 part per 10^{7}
Non-Harmonic Signal Content	At least 110 dB below required outputs

Table 1-3. Capabilities and Limitations (Continued)

Characteristic	Capabilities and Limitations
Harmonics Content of 5 MHz and 1 MHz Outputs	At least 40 dB below required outputs
Phase Lock Range	1 part per 10^8
SSB Noise dB/Hz Frequency from Carrier: 10 Hz 100 Hz 1 KHz 10 KHz	5 MHz / 1 MHz -130 dB / -135 dB -140 dB / -140 dB -160 dB / -145 dB -165 dB / -150 dB
Synchronization Delay	Less than 0.200 microseconds
Time Base Synchronziation:	
1 PPS	1 volt peak-to-peak, minimum, greater than 5 microsecond pulse width
1 MHz/1 PPs (1 PPS + 1 MHz sine wave, algebraically added)	Equal amplitudes of 1 to 3 volts peak-to-peak, minimum, greater than 5 microsecond pulse width
1 MHz/1 PPS (1 PPS + 1 MHz square wave, algebraically added)	Equal amplitude of 1 to 3 volts peak-to-peak, minimum, greater than 5 microsecond pulse width
1 PPS Waveshape	+4.7 volts ±10% into 50 ohms 20 microseconds ±1 microsecond wide, rise time less than 20 nanoseconds, jitter less than 100 picoseconds (unsynchronized)
1 MPPS Waveshape	+3.4 volts peak to peak, ±10% into 1000 ohms (1.2 volts rms) T^2L compatible, 0.8 microsecond wide

Table 1-4. Rated Outputs

Output	Rating
Analog Outputs:	
5 MHz sine wave	Greater than 1.0 volt rms into 50 ohms
1 MHz sine wave	Greater than 1.0 volt rms into 50 ohms
100 KHz square wave	Greater than 1.0 volt peak-to-peak into 50 ohms
Digital (Timing Pulse) Outputs:	
1 PPS	+4.7 volts ±10% peak-to-peak into 50 ohms, 20 microseconds ±1 microsecond wide
1 MPPS	+3.4 volts peak-to-peak, ±10% into 1000 ohm (1.2 volts rms) T^2L compatible, 0.8 microsecond wide

Table 1-5. Environmental Characteristics

Condition	Specification
Ambient operating temperature	0° C to +50° C
Ambient operating humidity	0 to 95% relative humidity
Storage temperature	-28° C to +65° C
Storage humidity	95% relative humidity
Transient Transportation Temperature (Non-Operating)	-62° C to +65° C

Table 1-6. Equipment, Accessories and Documents Supplied

Qty	Nomenclature	CID Number	Overall Dimensions	Weight and Volume			
				Crated		Uncrated	
				Weight (lbs)	Volume (cu in.)	Weight (lbs)	Volume (cu in.)
1	Frequency-Time Standard AN/URQ-23		Uncrated: 15-15/16 in. deep x 5-1/2 in. wide x 7-3/4 in. high Crated: 21 in. deep x 9-1/2 in. wide x 12 in. high	30	2,394	23	679
1	Technical Manual, Operation and Organizational Maintenance Instructions with Parts List for Frequency-Time Standard AN/URQ-23		8-1/2 in. wide x 11 in. high x 1 in. deep	N/A	N/A	1	23.4

Table 1-7. Equipment Required But Not Supplied

Category	Recommended Equipment	Alternate(s)	Equipment Test Parameters	Application
Electronic Counter	Frequency Counter AN/USM-207	Frequency Counter HP5360ADR, HP5370A, HP5345	5MHz, 1 MHz, and 100 KHz	Frequency Measurements for trouble-shooting and performance testing
Multimeter	Multimeter AN/USM-311	Multimeter AN/PSM-4	115 volts ac, +22 to +30 volts dc	Voltage measurements for trouble-shooting and performance testing
Rf Voltmeter	RMS Voltmeter CCVO-92 Series	RMS Voltmeter CCVO-91 Series	1 volt peak-to-peak	Voltage measurements for trouble-shooting and performance testing
Oscilloscope	Oscilloscope AN/USM-425(V)	Oscilloscope AN/USM-281	1 MPPS and 1 PPS	Waveform observations for trouble-shooting and performance testing

NOTE:

If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated Frequency-Time Standard; or an Omega, Loran-C, or Verdin Rf Transmission.

Table 1-8. Field and Factory Changes
(See paragraph 1-8.)

Change Number	Nomenclature	Description

CHAPTER 2

OPERATION

2-1. INTRODUCTION. This chapter presents instructions for the operation of the Frequency-Time Standard AN/URQ-23. Operating controls and indicators, operating procedures, and operator's maintenance are described. Controls and indicators used in the operation of the standard are all contained on the front and rear of rf oscillator A1 (figures 2-1 and 2-2). In addition, operations involving a switch that is located on the rear of battery power supply A3 may be required. (See figure 2-3.) During normal operation, the operator uses the controls and indicator on the front and rear of rf oscillator A1 to prepare the standard for operation. Thereafter, the standard operates automatically, requiring the attention of the operator only in the event of an equipment failure or a change in the mission of the standard. The switch on the rear of battery power supply A3 is used during installation and before storing or transporting the standard.

2-2. CONTROLS AND INDICATORS. The controls, indicators and connectors used during operation of the standard are listed in table 2-1. A description of each function and a reference to the applicable figure and index number is also provided.

INDEX FOR FIGURE 2-1

1 COARSE ADJUST control (Hidden)
2 TIME CONSTANT switch
3 FINE ADJUST control (Hidden)
4 PARTS IN 10^{11} (FINE FREQ. ADJ.) indicator dial
5 CIRCUIT CHECK switch
6 CIRCUIT CHECK meter
7 5MHZ IN connector
8 SYNC indicator
9 1PPS OUT connector
10 SYNC MODE switch
11 UNLOCK indicator
12 1PPS IN connector
13 5MHZ OUT connector
14 1MHZ OUT connector
15 100KHZ OUT connector
16 RESET pushbutton
17 BATTERY CHARGE switch
18 AC indicator

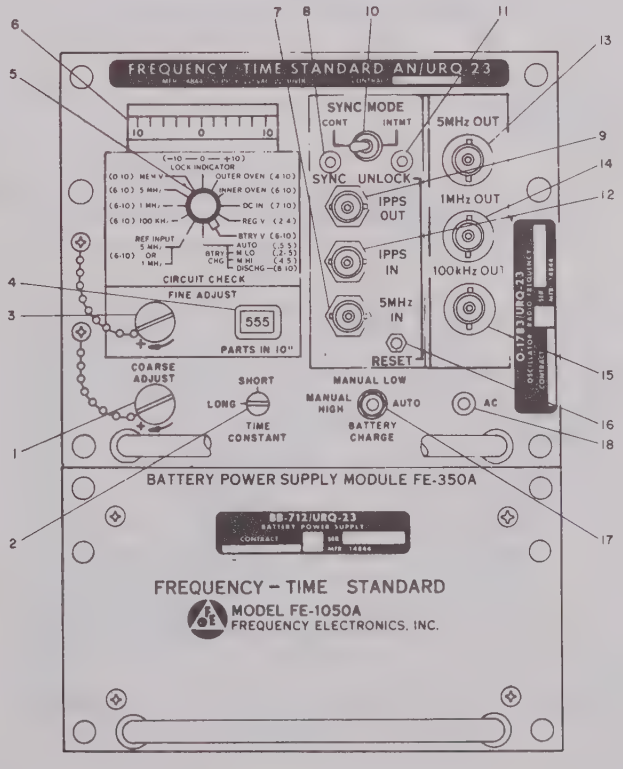
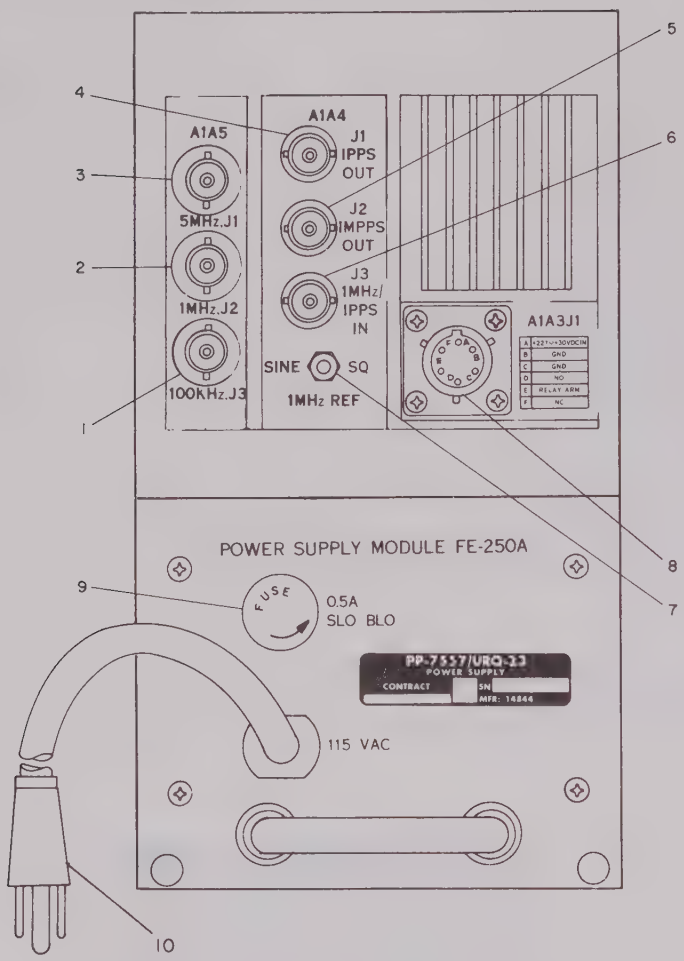


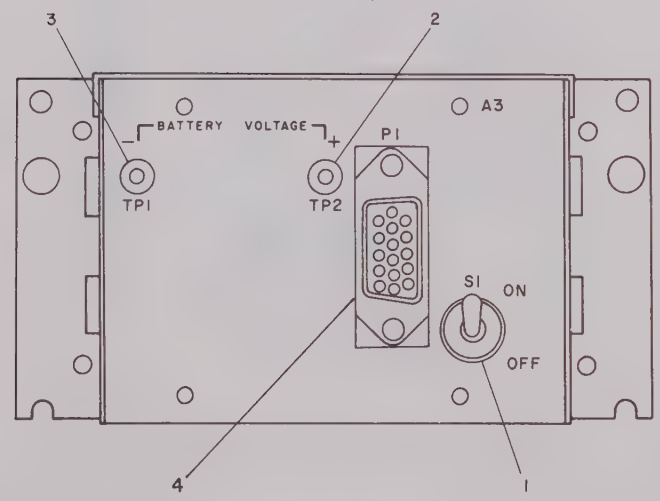
Figure 2-1. Front Panel Controls, Indicators, and Connectors



INDEX FOR FIGURE 2-2

1 100KHZ, J3 connector
2 1MHZ, J2 connector
3 5MHZ, J1 connector
4 J1 PPS OUT connector
5 J2 1MPPS OUT connector
6 J3 1MHZ/1PPS IN connector
7 1MHZ REF SINE/SQ switch
8 A1A3J1 connector
9 0.5A SLO BLO fuse and fuse holder
10 AC Power Line Cord

Figure 2-2. Rear Panel Controls, Indicators, and Connectors



INDEX FOR FIGURE 2-3

1 ON/OFF switch
2 TP2 test point, BATTERY +
3 TP1 test point, BATTERY -
4 A3P1 Connector

Figure 2-3. Rear View of Battery Power Supply A3 Control and Test Points

Table 2-1. Operating Controls, Indicators, and Connectors

Control Indicator, or Connector	Figure and Index No.	Function
COARSE ADJUST control	2-1 -1	Adjusted to provide coarse range of output frequencies of standard.
TIME CONSTANT switch	2-1 -2	Positioned to select response time of loop time constant for standard when it is phase locked to an external reference signal.
FINE ADJUST control	2-1 -3	Adjusted to provide vernier correction of output frequencies of standard.
PARTS IN 10^{11} (Fine Freq. Adj.) indicator dial	2-1 -4	Provides indication of frequency change in least significant digit of frequency count.
CIRCUIT CHECK switch	2-1 -5	Positioned to select test value to be indicated on CIRCUIT CHECK meter. Value that should be observed is marked on panel next to associated switch position.
CIRCUIT CHECK meter	2-1 -6	Deflects to indicate function selected for test by positioning of CIRCUIT CHECK switch.
5MHZ IN connector	2-1 -7	Provides point of connection for 5MHz phase lock reference input signal.
SYNC indicator	2-1 -8	Illuminated to indicate status of time synchronization. Extinguished when 1PPS output is not being generated; illuminated with short flashes (20-percent on/80-percent off) when 1PPS output is being generated, but not synchronized with input 1 PPS signal; illuminateed with long flashes (80-percent on/20-percent off) when 1 PPS output is being generated and is sychronized with input 1 PPS signal.
1 PPS OUT connector	2-1 -9	Provide point of connection for 1 PPS output of standard.

Table 2-1. Operating Controls, Indicators, and Connectors (Continued)

Control Indicator, or Connector	Figure and Index No.	Function
SYNC MODE switch	2-1 -10	Positioned to select mode of sychronization that is to be performed. In CONT position, outputs of standard are synchronized with each pulse of input synchronizing signal. In INTMT position, outputs of standard are synchronized with first received input signal, only.
UNLOCK indicator	2-1 -11	Illuminated if standard is not locked or lock is interrupted to 5 MHz or 1 MHz phase lock reference input signal, whichever is applied. Once illuminated, it remains illuminated until RESET pushbutton is pressed.
1PPS IN connector	2-1 -12	Provides point of connection for 1 PPS input signal used to synchronize 1 PPS time base output.
5MHZ OUT connector	2-1 -13	Provides point of connection for 5 MHz sine wave output of standard.
1MHZ OUT connector	2-1 -14	Provides point of connection for 1 MHz sine wave output of standard.
100KHZ OUT connector	2-1 -15	Provides point of connection for 100 KHz square wave output of standard.
RESET pushbutton	2-1 -16	Pushed to reset circuits that detect phase unlocked conditon.
BATTERY CHARGE mode switch	2-1 -17	Positioned to select mode of charging for batteries in battery power supply A3. Positioned to MANUAL HIGH to establish constant-current charging mode at rapid charging rate. Positioned to MANUAL LOW to establsih constant-current charging mode at slow charging rate. Positioned to AUTO to establish constant voltage taper charging.
AC indicator	2-1 -18	Illuminated when external ac power source is connected to standard and is supplying 115 volts.

Table 2-1. Operating Controls, Indicators, and Connectors (Continued)

Control Indicator, or Connector	Figure and Index No.	Function
100KHZ connector, J3	2-2 -1	Provides point of connection for 100 KHz square wave output of standard.
1MHZ connector, J2	2-2 -2	Provides point of connection for 1MHz sine wave output of standard.
5MHZ connector, J1	2-2 -3	Provides point of connection for 5MHz sine wave output of standard.
1PPS OUT connector, J1	2-2 -4	Provides point of connection for 1 PPS output of standard.
1MMPS OUT connector, J2	2-2 -5	Provides point of connection for 1 MPPS output of standard.
1MHZ/1PPS IN connector, J3	2-2 -6	Provides point of connection for 1PPS added on 1MHz carrier, or 1MHz without 1 PPS (sine or square wave) phase lock reference input as well as 1 PPS synchronization input.
1MHZ REF switch	2-2 -7	Provides selection of either sine of square wave 1 MHz reference input at A1A4J3.
A1A3J1 connector	2-2 -8	Provides point of connection for external dc power source input and alarm signal output. External dc power should be between +22 and +30 volts dc. Alarm signal indicates failures of ac source.
0.5A Slo Blo fuse	2-2 -9	Protects equipment from incoming ac power surges.
AC power line cord	2-2 -10	Provides for connection of ac power to the standard.
ON/OFF switch (Battery)	2-3 -1	Positioned to ON for normal operation. Positioned to OFF to disconnect the battery pack from the standard for long term storage or transit.
Test point TP2 Test point TP1	2-3 -2 2-3 -3	Allow verification of battery voltage. TP2 is positive terminal and TP1 is negative terminal.
A3P1 connector	2-3 -4	Provides interconnection between A3 module and chassis.

2-3. OPERATING PROCEDURES. Instructions for the operation of the standard are described in table 2-2. Operation consists of making connections between the standard and the external equipment with which the standard is to function, applying power, preliminary setup, monitoring actual operation (which is automatic), and removing power. A number of the procedures to be performed are accomplished in accordance with requirements dictated by the external equipment with which the standard is connected and the associated conditions of operation. Indications of when these procedures are to be performed are dictated by the operator for the installation configuration.

Table 2-2. Operating Procedures

Action Performed	Procedure
Equipment Connection	The input, output, and power connections to the standard are determined by the requirements of the installation in which the standard is used. These requirements may vary from site to site and from application to application of the standard. (Typical equipment connections are shown in figure 8-3.) Make the required connections in accordance with the following applicable steps: NOTE An ac power convenience outlet and an appropriate dc power supply must be available for connection to the standard. a. Make electrical power connections as follows: (1) If external ac power is to be used, connect ac line cord at rear of standard (figure 2-2) to 115 volt outlet. Ac power can be at 50, 60, or 400 Hz, single phase. (2) If external dc is to be used to power the standard, connect an external dc source with voltage between +22 and +30 volts to A1A3J1 connector (8, figure 2-2). (3) Turn on battery power supply A3 by loosening four captive knurled screws that secure the module to the chassis, sliding the A3 module out of the enclosure, and setting the ON/OFF switch (1, figure 2-3) to the ON Position. b. Make output connections to the standard as follows: (1) If remote equipment is to receive 5MHz sine wave outputs of the standard, connect RG-58/U coaxial cable to 5MHZ OUT connector (13, figure 2-1) to remote equipment.

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Equipment Connection (Continued)	NOTE An alternate or additional connection of the 5 MHz sine wave outputs of the standard can be made from 5MHz, J1 connector (3, figure 2-2) at the rear of the standard. (2) If remote equipment is to receive 1 MHz sine wave outputs of the standard, connect RG-58/U coaxial cable to 1MHZ OUT connector (14, figure 2-1) to remote equipment. NOTE An alternate or additional connection of the 1MHz sine wave outputs of the standard can be made from 1 MHz, J2 connector (2, figure 2-2) at the rear of the standard. (3) If remote equipment is to receive 100 KHz square wave outputs of the standard, connect RG-58/U coaxial cable to 100KHz OUT connector (15, figure 2-1) to remote equipment. NOTE An alternate or additional connection of the 100 KHz square wave output of the standard can be made from 100KHz, J3 connector (1, figure 2-2) at the rear of the standard. (4) If remote equipment is to receive 1PPS digital (pulse) outputs of the standard, connect RG-58/U coaxial cable to 1 PPS OUT connector (9, figure 2-1) at the front of the standard to remote equipment. NOTE An alternate or additional connection of the 1PPS digital outputs of the standard can be made from J1, 1 PPS OUT connector (4, figure 2-2) at the rear of the standard. (5) If remote equipment is to receive 1 MPPS digital (pulse) outputs of the standard, connect RG-58/U coaxial cable to J2 1 MPPS OUT connector (5, figure 2-2) at the rear of the standard to remote equipment. (There is no front panel source of this signal on the standard.)

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Equipment Connection (Continued)	c. Make standard input connections as follows: (1) If the phase of the standard outputs is to be locked to the 5 MHz carrier phase reference input, connect RG-58/U coaxial cable from remote equipment to 5MHz IN connector (7, figure 2-1) at the front of the standard. If the phase of the standard outputs is to be locked to a 1 MHz carrier phase reference input, connect RG-58/U coaxial cable from remote equipment to 1 MHz/1 PPS IN connector (6, figure 2-2) at the rear of the standard. The 1 MHz carrier should be a sine or square wave either of which may also be algebraically added to a 1PPS signal. (2) If the time base of the standard 1 PPS output is to be synchronized with a 1 PPS synchronizing input, connect RG-58/U coaxial cable from remote equipment to 1 PPS IN connector (12, figure 2-1) at the front of the standard.
Equipment Turn-On	With the exception of battery power, the standard is turned on by energizing the external power sources. Battery power is turned on by performing the procedure in step a (3) of the Equipment Connection procedure. Turn on the standard in the following sequence: a. If an external ac power source is to be used, turn on the external primary ac power source. b. Observe the AC indicator (18, figure 2-1) on the front of the standard. If ac power is being received, the AC indicator should be illuminated. If it is not illuminated, check the connection of the ac power cord to the external power source convenience outlet; if the connection is good have maintenance personnel determine the cause of the trouble. c. If an external dc power source is to be used, turn on the external dc power source.
Preliminary Setup	With the desired equipment connections made and power applied to the standard, perform the following preliminary setup procedure to ready the standard for automatic operation. a. Place the TIME CONSTANT switch (2, figure 2-1) to the SHORT position.

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Preliminary Setup (Continued)	b. Place the SYNC MODE switch (10) to the CONT position. c. Place the BATTERY CHARGE switch (17) to the AUTO position. NOTE The switch settings established in the three preceding steps are the recommended settings for the standard. These settings should not be changed unless operating conditions the system operator to do so. d. Allow at least 1 hour for warmup of the standard to stabilize within locking range. Applications which have no Calibrated Reference Signal Source connected require 24-hour warmup for greater stability. e. Position the CIRCUIT CHECK switch (5) to each of the OUTER OVEN and INNER OVEN settings. With the switch in the OUTER OVEN setting, the CIRCUIT CHECK meter (6) should deflect to a value between 4 and 10; in the INNER OVEN setting, the meter should deflect to a value between 6 and 10. If the meter reading is incorrect for either or both switch settings, allow more warmup time for the standard. If the readings are not correct within 1-1/2 hours, have maintenance personnel determine the cause of the trouble. f. Place the CIRCUIT CHECK switch to each of the positions listed below and observe the indicated reading on the CIRCUIT CHECK meter. If any reading is incorrect, have maintenance personnel determine the cause of the trouble. Switch Position — Meter Reading REF INPUT 5MHZ OR 1MHZ — +6 to +10 100KHZ — +6 to +10 1MHZ — +6 to +10 5 MHZ — +6 to +10 MEM V: If standard is locked to reference — +1 to +9 (normally adjusted to +5) If standard is not locked or there is no reference — 0 to 10 (or any other reading) LOCK INDICATOR: If there is no reference — +6 to +9 If there is a reference, but standard is not locked to it — Sweeps from -10 to +10 If standard is locked to reference — 0

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Preliminary Setup (Continued)	OUTER OVEN +4 to +10 INNER OVEN +6 to +10 DC IN +7 to +10 (if external dc is connected) REG V +2 t +4 BTRY V *+6 to +10(ac power secured) BTRY CHG: With BATTERY CHARGE switch in AUTO +0.5 to +5.0 tapering to 0.5 when battery is fully charged With BATTERY CHARGE switch in MANUAL LOW +0.2 to +0.5 With BATTERY CHARGE switch in MANUAL HIGH +4 to +5 With external power off -8 to -10, battery is in discharge (* = +8.5 to +9.5 for fully charged battery) g. Place the BATTERY CHARGE switch (17) to the AUTO position, if it is not already in that position. h. Allow the standard to operate with power on, as described above for at least an additional 24 hours. i. Determine whether the standard is to be operated with the phase of its outputs locked to the phase of an external reference signal or not. If the phase is to be locked, proceed as follows: NOTE If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipments or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C, or Verdin RF Transmission.

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Preliminary Setup (Continued)	(1) Make certain that that a Calibrated Reference Signal Source has been connected to the 5MHz IN connector (7, figure 2-1) on the front of the standard, or to the J3 1MHZ/1 PPS IN connector (6, figure 2-2) on the rear of the standard. If connected to the rear of the standard, make certain that the 1MHZ REF switch (7, figure 2-2) is in the correct position: SINE (if the input is a sine wave), or SQ (if the input is a square wave). (2) Make certain that the TIME CONSTANT switch (2, figure 2-1) is in the SHORT position. (3) Place the CIRCUIT CHECK switch (5, figure 2-1) to the LOCK INDICATOR position. (4) Observe the reading on the CIRCUIT CHECK meter (6); it will probably sweep back and forth across 0 at a rate that is determined by the difference between the frequencies of the standard and the external reference signal. (5) Remove the protective cap from the COARSE ADJUST control (1) and, using a screwdriver, adjust the control to produce a fixed reading of 0 (no longer sweeping) on the CIRCUIT CHECK meter. NOTE: This may take a few minutes. (6) Place the CIRCUIT CHECK switch to the MEM V position. If the phases are locked, the CIRCUIT CHECK meter should read a fixed value between +1 and +9, indicating that the COARSE ADJUST control setting is within range. (7) Adjust the COARSE ADJUST control to bring the reading on the CIRCUIT CHECK meter +5. Turn the control clockwise to reduce the reading, counterclockwise to increase it. (8) Place the CIRCUIT CHECK switch to the LOCK INDICATOR position. The CIRCUIT CHECK meter should read a fixed value of 0. If it does not, perform or repeat steps (4) through (7). (9) Observe the UNLOCK indicator (11, figure 2-1) on the front of the standard. If the indicator is illuminated, press the RESET pushbutton (16); the indicator should be extinguished.

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Preliminary Setup (Continued)	NOTE At this point, the external reference signal can be disconnected from the standard. The frequency of the standard will remain at the frequency of the external reference signal, drifting at the frequency aging rate shown in table 1-3. (10) If conditions make it necessary, the TIME CONSTANT switch (2, figure 2-2) can be placed to the LONG Position, when the operator so directs. (11) If the time base outputs of the standard are to be synchronized with an external synchronizing input applied at the 1 PPS IN connector (12, figure 2-1) on the front of the standard, or the J3 1MHZ/1 PPS IN connector (6, figure 2-2) at the rear of the standard, place the SYNC MODE switch (10, figure 2-1) in the position that corresponds to the mode that is dictated by the nature of the input synchronizing signal: CONT, if the synchronizing signal is clean and can remain connected (the standard will synchronize on each input pulse); INTMT, if the synchronizing signal is noisy, intermittent, or must be disconnected (the standard will synchronize on the first pulse, only). (12) Observe the SYNC indicator (8, figure 2-1) to determine the status of the synchronization. The indicator will flash with a longer on than off time, if there is a 1 PPS output from the standard and that output is synchronized. The indicator will flash with a longer off than on time, if there is a 1 PPS output but it is not synchronized. The indicator will not light at all, if there is no 1 PPS output from the standard. (13) This concludes the Preliminary Setup procedures.
Monitoring Operation	Operation of the standard is automatic and essentially continuous. However, there are a certain number of monitoring operations that should be performed to make certain that operation is continuing without incident. Perform the following steps to accomplish monitoring actions:

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Monitoring Operation (Continued)	a. If the standard has been phase locked to an external reference, observe the UNLOCK indicator at frequent intervals or whenever possible. The UNLOCK indicator should not be illuminated if the reference is connected and the standard is correctly locked. b. If the standard is synchronized with an external 1 PPS source, observe the SYNC indicator at frequent intervals or whenever possible. The SYNC indicator should always flash. The on time of the SYNC indicator should be longer than the off time (if there is a 1 PPS output and the standard is synchronized in frequency). c. Maintain a constant observation of the remote alarm or status indicator that is cabled to the A1A3J1 connector (8, figure 2-2) at the rear of the standard. If an alarm is sounded or otherwise indicated, the standard has lost external ac power and is operating on external dc power or on internal battery power. Corrective action should be taken as soon as possible to restore external primary power to the standard; the minimum battery operating time is 7 hours. As soon as the batteries have discharged to a certain point, the standard will be turned off automatically. NOTE If a calibrated reference signal source is not available, the COARSE ADJUST control should not be altered. d. If the standard is known to have drifted from the proper frequency because of the passage of time, (See table 1-3, Aging Rate, for estimates of frequency error over-time) adjust for the correct frequency in accordance with
Equipment Turn off	Before turning off the standard, keep in mind that the entire preliminary setup procedure, including suitable warm up time, must be repeated before placing the standard back in operation. To turn off the standard, all external power must be turned off or disconnected and the following steps performed: a. Loosen the four captive knurled screws that secure battery power supply A3 to the standard enclosure. These screws are accessible from the front of the standard. (See figure 2-1.) b. Slide battery power supply A3 out of the enclosure.

Table 2-2. Operating Procedures (Continued)

Action Performed	Procedure
Equipment Turn-off (Continued)	c. Place the ON/OFF switch (1, figure 2-3) to the OFF position. d. Replace and secure battery power supply A3 in the enclosure.
Emergency Turn-off	If an emergency makes it necessary to turn off the standard, perform the equipment turn-off procedures described above.

2-4. OPERATOR CHECKS AND ADJUSTMENTS. Operator checks and adjustments are described in the following subparagraphs.

a. Operator Checks. Operator checks consist of performing steps a through g in the Preliminary Setup procedure of table 2-2 and of performing the monitoring operations described therein.

b. Operator Adjustments. Operator adjustments consist of establishing the correct output frequencies for the standard. To perform these adjustments, proceed as follows:

NOTE

If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C or Verdin RF Transmission.

(1) Connect calibrated reference signal source to the standard by applying either a 5 MHz reference input to the 5 MHZ IN connector (7, figure 2-1), or a 1 MHz sine (or square) wave to the J3, 1 MHZ/1 PPS IN connector (6, figure 2-2).

NOTE

FINE ADJUST control must be pre-set to a defined point before proceeding.

(2) Apply external ac or dc power to the standard by connecting the ac line cord at the rear of the standard to an ac power source, or by connecting a +22 to +30 volts dc source to the A1A3J1 connector (8, figure 2-2).

(3) Turn on the external power source. If the external power source is 115-volts ac, observe that the AC indicator (18, figure 2-1) on the front of the standard is illuminated.

(4) Allow at least a 1-hour warmup. A 24-hour warmup and stabilization period is preferred.

(5) Place the TIME CONSTANT switch (2) to the SHORT position.

(6) Place the CIRCUIT CHECK switch (5) to the LOCK INDICATOR position.

(7) Observe the CIRCUIT CHECK meter (6). If the reading of the meter varies back and forth between -10 and +10, the standard is not locked to the phase reference input signal; that is, there is a frequency difference between the ouput of the standard and the phase reference input signal. This difference is greater than phase lock captured range. Therefore, a coarse frequency adjustment is necessary to bring the internal oscillator frequency closer to the external reference frequency. This adjustment also allows the internal oscillator frequency to be brought into locking range.

NOTE

If a calibrated reference signal source is not available, the COARSE ADJUST control should not be altered.

(8) Remove the protective cap from the COARSE ADJUST control (figure 2-1).

(9) Using a screwdriver, change the setting of the COARSE ADJUST control to stop the sweeping of the CIRCUIT CHECK meter at a value of 0.

10) Place the CIRCUIT CHECK switch to the MEM V position.

11) Observe the CIRCUIT CHECK meter after an interval of a few minutes. If the phase of the standard output is locked to the phase of the phase lock reference input, a fixed value between +1 and +9 is observed. If a fixed value other than +5 is observed, adjust the COARSE ADJUST control with a screwdriver to establish a value of +5 on the CIRCUIT CHECK meter. Turn the control clockwise to reduce

the value read, counterclockwise to increase it. If operation of the COARSE ADJUST control cannot produce the desired results, have maintenance personnel determine the cause.

(12) To adjust for frequency drift, remove the protective cap of the FINE ADJUST control (3, figure 2-1) and adjust the control through the number of increments on the PARTS IN 10^{11} dial (4) that will provide the necessary correction.

(13) If the UNLOCK lamp is still illuminated, press the RESET pushbutton switch (16, figure 2-1). The indicator should be extinguished; if not, have maintenance personnel determine the cause.

2-5. OPERATOR MAINTENANCE ACTIONS AND SCHEDULES. Operator maintenance actions and the schedules for their performance are described in the Planned Maintenance System (PMS) document MIP no. C-434/P3-70. If the PMS document is not available, perform the following:

a. On a monthly basis, perform the operator checks described in subparagraph 2-4a.

b. On a daily basis, observe that the AC indicator is illuminated and that external ac power is applied.

c. On an annual basis, or sooner if the monthly check indicates the necessity, replace the battery pack in battery power supply A3 as described in paragraph 4-8.

d. On an annual basis, perform the cleaning and inspection described in paragraph 4-4.

CHAPTER 3

FUNCTIONAL DESCRIPTION

3-1. INTRODUCTION. This chapter contains a functional description of the standard. The functional operations of the overall standard and of the modules contained in it are described. Functional descriptions are presented at two levels, the general system level and the module assembly level.

3-2. OVERALL BLOCK DIAGRAM DESCRIPTION. An overall block diagram of the standard is shown in figure 3-1 and detailed block diagrams are shown in figures 3-2 and 3-3.

a. Output Frequency Generation. Rf oscillator A1 contains a precision, 5 MHz, quartz oscillator which is the primary source of all analog (sine or square wave) and digital (pulse) signal outputs produced by the standard. Rf oscillator A1 also generates the remote alarm indicator signal in the event of a primary ac power loss.

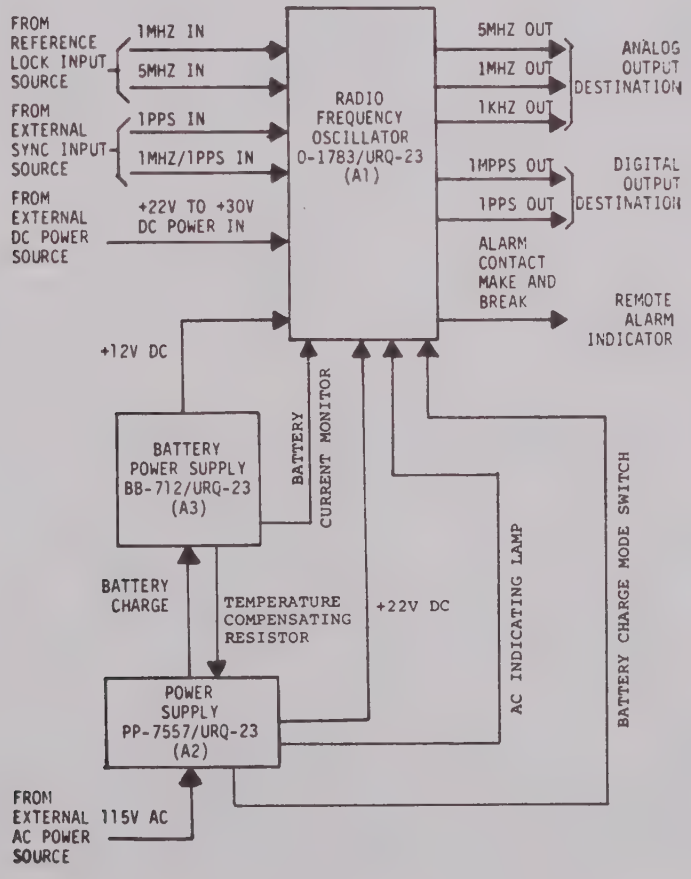


Figure 3-1. Overall Block Diagram

b. Phase Lock System. The precision, 5 MHz, quartz oscillator is a voltage controlled oscillator (VCO) which can be phase-locked to a higher order, external reference signal (either 5 MHz or 1 MHz) and electronically tuned. The phase lock comparison frequency is 1 MHz. Therefore, the 5 MHz reference input is divided by 5 to generate 1 MHz or the 1 MHz reference input is directly used for comparison with the 1 MHz generated from the internal 5 MHz quartz oscillator. The error signal from the output of the phase comparator controls the quartz oscillator. An electronic storage (memory) circuit is incorporated in between the phase comparator output and the quartz oscillator VCO input. Upon loss or removal of the 5 MHz or 1 MHz input signal, the memory circuit retains the last, locked frequency, dc voltage input to the VCO thereby preventing any large frequency or phase perturbation in the output signals and allowing the standard to transition smoothly from the phase-locked, long-term stability of the higher order, external reference source to its inherent, free-running long-term stability specified in table 1-3.

c. Quartz Oscillator Frequency Tuning System. The oscillator fine and coarse frequency adjustments are used to manually reset the oscillator output frequency. This is achieved by manually adjusting the dc voltage to the VCO through the loop filter operational amplifier. The adjustment range is normally from one part in 10^8 to one part in 10^7 for fine and coarse respectively. The phase lock loop range is designed for one part per 10^8.

d. Time Base 1 PPS Synchronization System. The internally generated time base 1 PPS output has the capability to being synchronized with an external 1 PPS time base with an accuracy of less than 0.2 microseconds. In order to achieve this accuracy, the synchronization circuit must operate at a 10 MHz signal rate. Therefore, the 5 MHz quartz oscillator output is doubled to generate 10 MHz. The synchronization delay is thereby minimized, and the 0.2 microsecond delay accuracy can be assured. The synchronization system also allows two modes of operation. The first mode is continuous synchronization, in which every 1 PPS output pulse is synchronized to every 1 PPS input pulse. The second mode of operation is intermittent synchronization, in which the 1 PPS output is only synchronized with the first 1 PPS input pulse received and all other 1 PPS input and noise pulses are ignored. A third, unsynchronized mode of operation is also possible.

e. Power Supply System and Distribution. The standard operates from three power sources. The first, normal primary power, is 115-volt ac, single phase. The second, stand-by dc power, is +22 to +30 volts dc. The third, emergency power, is an internal built-in 7-hour battery pack power supply. The operating sequence is automatic, switching from ac power to external dc power or to battery power, if external dc is not available. There is no discontinuity of operation when switching over from one power source to another. All input power sources are converted to +15 volts dc, -15 volts dc and +5 volts dc for standard applications. Battery charging current comes directly from the ac power supply source, so that the battery does not charge when operating from an external dc power source.

f. Alarm System. The standard's built-in alarm system consists of a set of relay transfer contacts connected to connector A1A3J1 at the rear of the standard. The alarm relay normally operates from the ac power source. Therefore, with any loss of ac power to the standard the relay is de-energized. The relay contacts make-and-break actions serve as alarm inputs to a remote alarm indicator.

g. Battery Charging Method. The battery used in the standard consists of ten nickel-cadmium rechargable "F" cells connected in series. It has a nominal voltage of 12 volts and total capacity of 7 ampere-hours. Three means of charging the battery are provided. The first method is a constant-current high charge at a 650 milliampere rate that fully charges the battery from the totally discharged state in approximately 16 hours.

CAUTION

Prolonging this high charge time overheats the battery and causes failure. However, if there is a bad or shorted cell, the battery pack may overheat due to the continuous high charge current. Maintenance and service personnel must replace the battery pack in such cases.

The second charging method is a constant current low charge at approximately 70 milliamperes. This maintains a fully charged battery at all times. This method is the recommended trickle charge mode after the battery is fully charged. The third charging method, auto-charge, constantly taper charges the battery. This method can only charge the battery to approximately 80 percent of its full capacity at best. The charge current reduces from 700 to 50 milliamperes as the battery terminal voltage increases.

h. Built-in Test Equipment (BITE) System. The standard has a built-in test circuit to monitor the performance of the standard. A circuit check, 12-position switch and meter are provided at the front panel. Relative meter readings are indicated for GO/NO-GO observations. The monitored functions are:

(1) 5 MHz or 1 MHz reference input

(2) 5 MHz output

(3) 1 MHz output

(4) 100 KHz output

(5) Memory voltage

(6) Lock indicator

(7) Outer oven temperature

(8) Inner oven temperature

(9) External dc input

(10) Internal regulated voltages

(11) Battery voltage

(12) Battery charge or discharge current

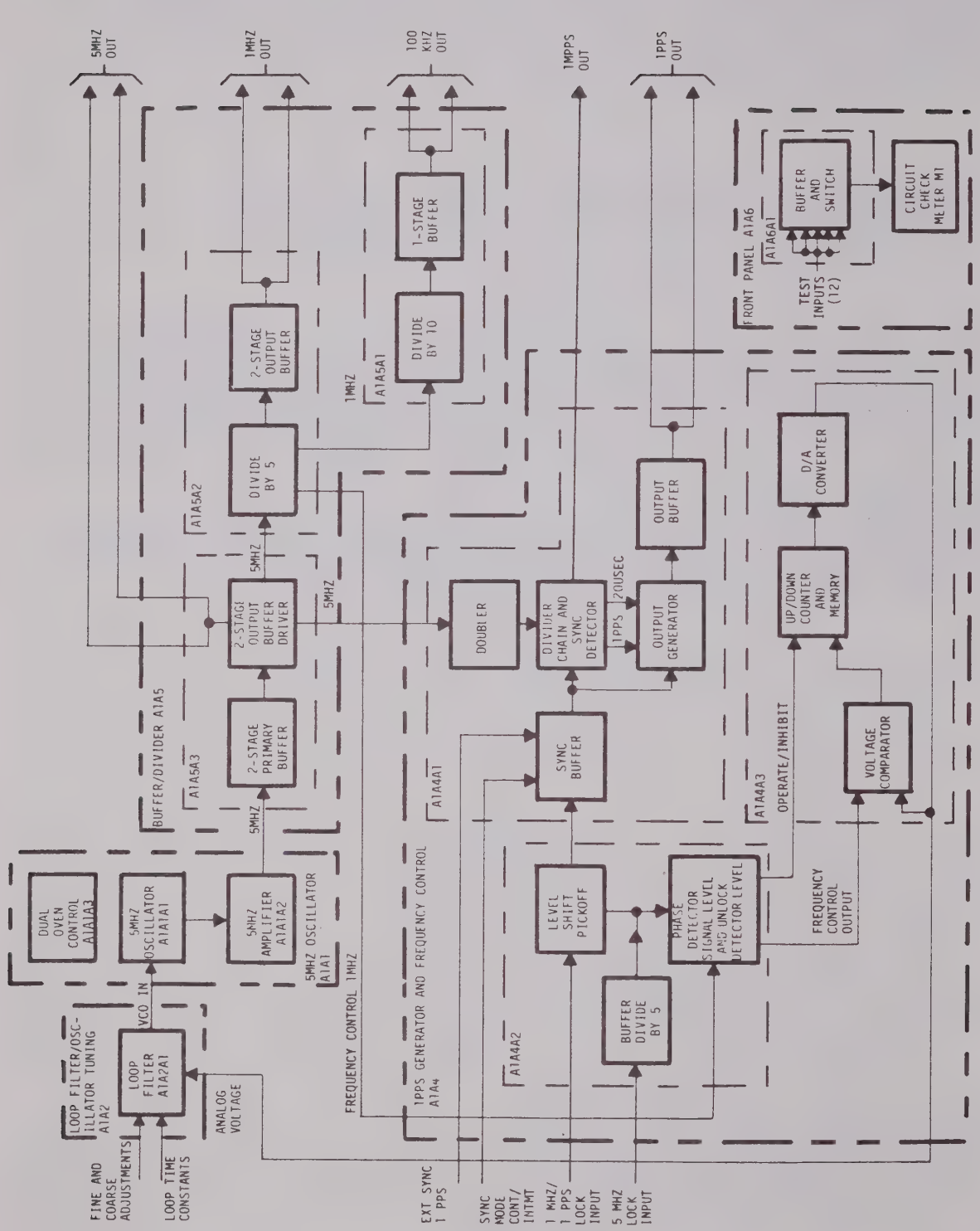


Figure 3-2. Signal Generating Functional Block Diagram

Three LED indicators are also provided at the front panel to monitor the operation of the standard. They are an AC power on/off indicator, a 1 PPS output SYNC indicator, and a phase lock loop UNLOCK indicator. These monitors permit observation of all important features of the standard, except the output frequency accuracy when operating in an unlocked mode. That mode requires external test equipment to measure accuracy.

3-3. MODULE/ASSEMBLY FUNCTIONAL DESCRIPTIONS. Module/Assembly functional descriptions are as follows:

a. Rf Oscillator A1. This module contains six assemblies shown in figure 1-2. The functional block diagrams for the module are shown in figure 3-2 and figure 3-3.

NOTE

The circuits shown in figures 3-2 and 3-3 are divided into assemblies, subassemblies, and stages for purposes of discussion only. During maintenance, troubleshooting should not be performed below the level of the assemblies in the module. Further troubleshooting is beyond the capabilities of organizational level maintenance technicians. Subassemblies must be forwarded to the authorized repair depot for repair.

The following descriptions of functional operations relate to the module or assembly in which they are performed:

(1) 5 MHz Oscillator A1A1. This assembly houses the precision 5 MHz voltage controlled quartz crystal oscillator. An "AT" cut, 5th overtone crystal is used to generate an ultrastable, precision 5 MHz signal. The temperature of the quartz crystal is controlled by cascading three heater controls in a shock-mounted Dewar Flask. The heaters are an inner oven heater, operating from -15 volts dc, and an outer oven heater and booster oven heater that operate from +15 volts and -15 volts dc, respectively. The booster heater is automatically turned on only during the initial turn-on, allowing the inner oven temperature to reach control faster. The booster oven automatically turns off and will remain off after warm-up. The oscillator circuit consists of an automatic gain control (AGC) loop to maintain constant crystal drive current. Voltage controlled oscillation is accomplished by using a voltage variable diode that has a range of 0 to 4 volts dc for a total of one part per 10^7 frequency change. The 5 MHz signal is buffered before being applied to the next assembly, A1A5.

(2) Loop Filter/Oscillator Tuning A1A2. In a phase lock loop system, it is necessary to have a loop response time for locking. Therefore, two time constants are used for the standard. One is a short (1 second) time constant for normal operation, and the second is a long (100 seconds) time constant for a noisy reference input or for a longer loop integration time. To accomplish this, a large value resistor (1200 megohms) and large value capacitor (10 microfarads) are used for integrating inputs to the operational amplifier. A relay is used for remotely switching the time constant. This loop filter system responds to two inputs: one from a detected dc error voltage from the phase lock loop through a voltage memory storage circuit (range one part per 10^8); the second, is received directly from fine and coarse adjustment potentiometers for resetting the input reference

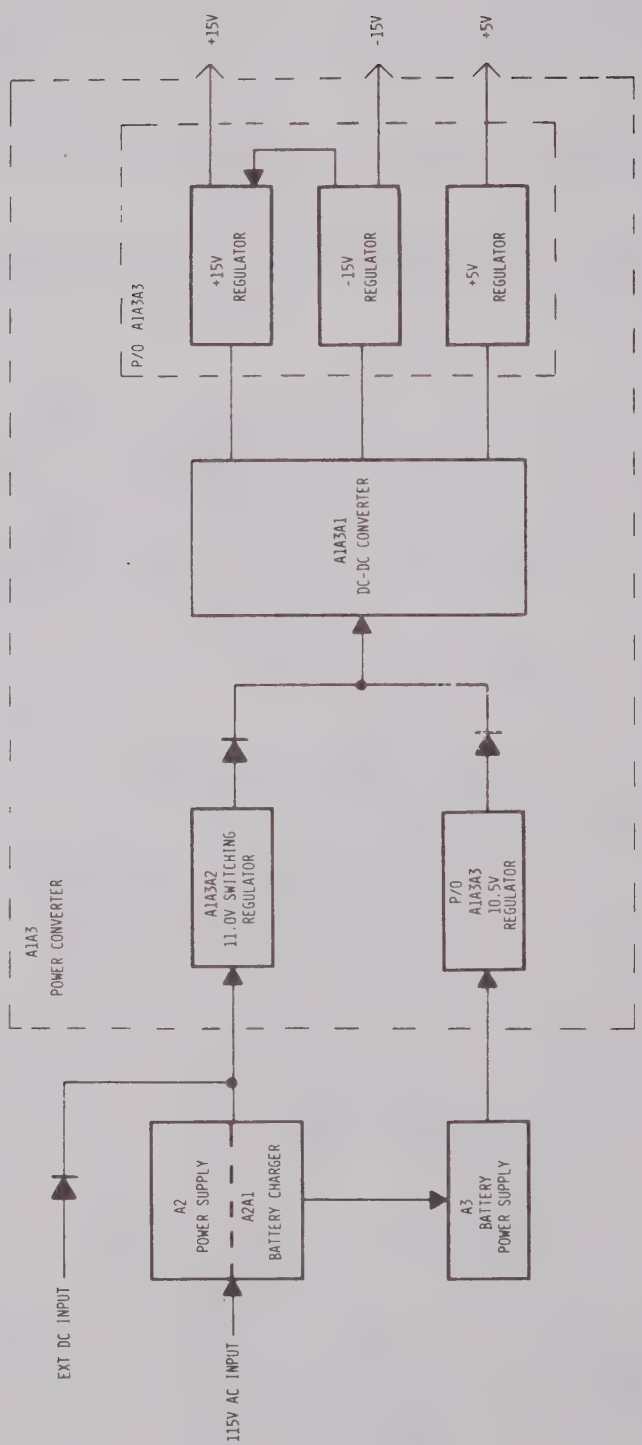


Figure 3-3. Power Control and Distribution Functional Block Program

voltage of the operational amplifier (range one part per 10^7). The output of this operational amplifier drives the oscillator VCO input for frequency shifting. Because of the high value of the time constant resistor and capacitor, loop filter sub-assembly A1A2A1 is hermetically sealed in a metal housing.

(3) Power Converter A1A3. The block diagram of the power supply system is shown in figure 3-3. The power converter assembly accepts three dc input power sources and converts them to regulated +15 volts, -15 volts and +5 volts dc for the standard. The conversion involves the use of a switching regulator, which accepts either external dc input (22 volts to 30 volts) or +22 volts from a rectified and filtered ac source. The output of this switching regulator is set for +11.0 volts. The battery pack A3 output is regulated to 10.5 volts through linear regulator A1A3A3. Both the 11.0 volt output and the 10.5 volt output are OR-gated to the input of dc/dc converter A1A3A1. Normally the 11 volt output operates dc/dc converter and the 10.5 volt output is used as a standby that only operates when both inputs to the switching regulator are absent. The outputs of the dc/dc converter are further regulated to +15 volts, -15 volts and +5 volts. The alarm relay is located within this assembly to sense the absence of ac power and automatically switch in the external dc input power, when available, or the battery power supply. The remote alarm indicator is also activated.

(4) 1 PPs Generator and Frequency Control A1A4. Two independent circuit sections are housed within this assembly.

(a) Time Base 1 PPS Output Section. A 5 MHz signal is received from buffer amplifier assembly A1A5. This 5 MHz is doubled to 10 MHz before the division chain is initiated. The external 1 PPS sync. system is operated at the 10 MHz level, so that the sync. resolution of 0.2 microseconds can be achieved. All division chains are synchronized to minimize the division delay. The precise 1 PPS, 20 microsecond pulse width is also formed within the division chain to generate this low-jitter, accurate, 20 microsecond pulse width, 1 PPS output. The 1 PPS sync. mode circuit is used for either the continuous or intermittent mode of operation. An inhibiting gate stops all input 1 PPS sync. signals except the first pulse which synchronizes the output. An LED indicator provides visual indication of 1 PPS sync. status. Short ON, long OFF operation indicates non-synchronization and long ON short OFF indicates synchronization. The 1 PPS sync. can be applied at two places, either at a front panel 1 PPS input connector, or at a rear panel 1 MHz/1 PPS IN connector. The rear panel input is used when the 1 PPS pulse is algebraically added to a 1 MHz sine or square wave signal. A level shift circuit picks off and separates the 1 PPS signal, used for synchronization of the internal 1 PPS signal, from the 1 MHz signal used for phase-locking the internal 1 MHz signal.

(b) Frequency Phase Lock Control Section. The phase lock detector is compared at a 1 MHz rate. Therefore, the 5 MHz reference input is divided by 5 to 1 MHz and then phase compared with the internal 1 MHz. Alternately, the 1 MHz reference input is phase compared with the internal 1 MHz signal directly. The error output of the phase comparator operates a memory storage system, which consists of a 12-bit D/A, A/D converter with a total bit count of 4096 bits and frequency resolution of approximately 2 1/2 parts per 10^{12} per bit. The analog output dc voltage operates in the hold position when the reference input signal is removed. This is accomplished by detecting the absence of the input reference signal and inhibiting the converter clock signal for the up-down counter. With the clock inhibited, the output analog dc voltage to the oscillator VCO input remains unchanged, and the oscillator output frequency remains unchanged.

(c) The 1 MPPS signal is picked off from the divider chain circuit, and buffered through a saturated transistor output circuit to provide a 1 MPPS signal at rear panel J2. The signal level is 0 to +3.4 volts ±10% peak-to-peak (1.2 volts rms), into a load of 1000 ohms and has a pulse width of 0.8 microsecond maximum.

(5) Buffer/Divider A1A5. All the 5 MHz, 1 MHz and 100 KHz outputs are generated within this assembly. The 5 MHz output amplifier consists of a one pole crystal filter with an AGC amplifier to deliver 1 volt rms into a 50 ohm load for both front and rear connectors. The 1 MHz output results from division of the 5 MHz signal by 5 and has an output amplifier similar to the 5 MHz except that it has no crystal filter. The 100 KHz output results from digitally dividing the 1 MHz signal by 10. The square wave output is dc coupled directly from an emitter follower circuit. Two additional signals are buffered in this module. One is a 5 MHz output applied to a 1 PPS generator's frequency doubler. The other is a 1 MHz output applied to a frequency control phase comparator circuit.

(6) Front Panel A1A6. Front panel A1A6 has mechanical cutouts that provide access to controls and indicators on other assemblies in rf oscillator A1. Front panel A1A6 also contains controls and indicators that are associated with power control and distribution functions and with built-in test equipment (BITE). The BITE items consist of an operational amplifier and a 12 position CIRCUIT CHECK switch on subassembly A1A6A1. It also includes circuit check meter M1. Disconnecting or removing of the front panel does not cause a malfunction or disturb the other modules. Meter readings are relative values, which are compared with a specified value for that switch setting in order to determine whether the test input is within specification or not.

b. Power Supply A2. This module can be removed from the rear of the standard, while the ac line cord is attached to its panel. The module consists of a step-down power transformer, bridge rectifier and two filter capacitors. It converts 115 volts ac to +22 volts dc at nominal load. A plug-in printed circuit card on the module houses the battery power supply charging circuit. The battery is charged in any of three different modes. Three operational amplifiers are used, one to sense current, another to sense battery voltage, and the third to control the series power transistor to provide constant current high charge, constant current low charge and constant voltage auto-charge (taper charge). The charger charges 12 volt nickel-cadmium "F" cells. If external dc is available, power supply A2 may be removed for servicing without interruption of operation. If external dc is not available, power supply A2 may still be removed without interruption of operation, but the standard will then be operating on power from the battery pack. Minimum capacity of a battery pack is 7 hours of operation, but it is recommended that extended operation on battery power be avoided.

c. Battery Power Supply A3. Battery power supply A3 provides an emergency power source for use in the event of failure of external power. The battery power supply consists of one pack of ten "F" cell nickel-cadmium batteries, which can be removed for service or replacement. The battery pack is rated at 7 ampere-hour capacity, with a maximum charging rate of 700 milliamperes for 16 hours (manual high charge) or an indefinite charge in auto-mode (taper charge). A low voltage cut-off circuit and relay is incorporated to prevent battery over discharge if the battery voltage drops below 10 volts. This drop causes the load to be disconnected from the battery. The relay will not be turned back on until ac power is applied. A manual ON/OFF switch is incorporated to turn off the battery pack during shipping and long term storage.

CHAPTER 4

SCHEDULED MAINTENANCE

4-1. INTRODUCTION. This chapter contains schedules and instructions for the performance of preventive maintenance procedures. Preventive maintenance procedures are accomplished on a scheduled basis in order to minimize equipment down time. The schedules for preventive maintenance are described, followed by instructions for the performance of the procedures that accomplish them. Scheduled maintenance instructions in this manual are cancelled when the Planned Maintenance System (PMS) is implemented for the equipment aboard your ship or station.

4-2. MAINTENANCE SCHEDULE. Table 4-1 lists the preventive maintenance procedures that must be performed on a scheduled basis. Procedures are listed in the Maintenance Action column of the table. The paragraph that describes the procedures is indicated in the Reference column. The interval at which the procedures are to be performed are listed in the Periodicity column. Periodicity column entries are presented in symbol form as follows:

Interval	Symbol
Monthly	M
Quarterly	Q
Annually	A

Table 4-1. Scheduled Maintenance Action Index

Periodicity	Maintenance Action	Reference
M	Performance verification test	4-9
Q	Battery power supply A3 maintenance	4-5
Q	Battery switchover & examination check	4-7
Q	Scheduled performance tests	4-6
A	Battery replacement	4-8
A	Preventive maintenance procedures	4-4

4-3. TOOLS, PARTS, MATERIALS, AND EQUIPMENT REQUIRED FOR SCHEDULED MAINTENANCE. The following tools, parts, materials, and equipment are required for scheduled preventive maintenance:

a. Lint-Free Cloths, National Stock No. 7920-205-3453

b. Soft, Non-metallic, Fiber Brush

c. Vacuum Cleaner with Non-Metallic Nozzle

d. 8-inch, Flat-head Screwdriver (Excelite No. R3164, or equivalent)

e. 8-inch, Phillips Screwdriver (Excelite No. X101, or equivalent)

f. Multimeter (Refer to table 1-7.)

4-4. PREVENTIVE MAINTENANCE PROCEDURES. The preventive maintenance procedures for the standard consist of cleaning and inspection described in the following subparagraphs:

a. Remove all power connections to the standard.

b. Disconnect all input and output signal cables from the standard. If the standard is rack mounted, loosen the mounting screws using a flat head screw driver and remove it from the rack.

c. Using a flat-head screwdriver, loosen the four front panel knurled-head captive fasteners that secure front panel A1A6 to the enclosure. (See figure 1-2.)

d. Remove front panel A1A6 from the rf oscillator A1.

e. Loosen the two knurled-head captive screws, two phillips hold-down screws, lockwashers and hold-bar, that secure the rear of rf oscillator A1 to the standard. (See figure 2-3.)

f. Slide rf oscillator A1 out of the standard from the front.

g. Loosen the three knurled-head captive fasteners that secure power supply A2 to the rear of the standard.

h. Slide power supply A2 out of the standard from the rear.

i. Loosen the four knurled-head captive screws that secure battery power supply A3 to the front of the standard.

j. Slide battery power supply A3 out of the standard from the front.

k. Using a vacuum cleaner with a non-metallic nozzle, vacuum the interior of the case of the standard to remove dust and dirt. Remove any remaining dust and dirt that is not drawn out by the vacuum cleaner, using a clean, lint-free cloth.

l. Using a soft, non-metallic, fiber brush and a clean, lint-free cloth, remove any accumulation of dirt, oxidation, and corrosion from the modules and assemblies of the standard and the mating connectors for the modules on the chassis.

m. Inspect for and remove any accumulation of oxidation and corrosion from the case of the standard, the A1A3J1 connector, the front panel controls and indicators, and the signal connectors of the standard, using the brush and cloth of step l.

n. Make certain that ON/OFF switch S1 is in the ON position. Slide battery power supply A3 back into the standard and secure it with the four knurled-head captive screws.

o. Slide power supply A2 into the standard and secure it with the three knurled-head captive screws.

p. Slide rf oscillator A1 into the standard and secure it with the two Phillips hold-down screws, lockwashers, holdbar and the two knurled-head captive fasteners at the rear of the standard.

q. Install front panel A1A6 on the standard and secure it with the four knurled-head captive front panel screws.

r. Replace all input and output cables and apply power.

4-5. BATTERY POWER SUPPLY A3 MAINTENANCE. To perform scheduled maintenance on battery power supply A3, proceed as follows:

a. Remove power and loosen the four knurled-head captive fasteners at the front of the standard that secure battery power supply A3.

b. Slide battery power supply A3 out of the standard.

c. Place ON/OFF switch S1 on battery power supply A3 to the OFF position.

d. Remove and retain the 10 Phillips screws that secure the top cover of the battery power supply.

e. Remove the top cover of the battery power supply and clean any accumulation of dirt from the inside of the battery pack.

f. If the battery pack is to be replaced, loosen (do not remove) the four Phillips screws (two in each side) that secure the two brackets that hold the battery pack in place.

g. Disconnect the battery pack connector by pulling the connector upward and away from the printed circuit board.

h. Replace a new battery pack with the same pack type and connect by plugging the keyed connector back into the printed circuit board. The red wire is the positive terminal and the black wire is the negative terminal.

i. Secure the two brackets against the battery pack and tighten the four Phillips screws on the sides. Ensure that the battery pack is correctly positioned and not loose.

j. Install the top cover in position and secure it with 10 Phillips screws.

k. Place the ON/OFF switch on battery power supply A3 to the ON position, if the battery is to be available as an emergency power source.

l. Connect the probes of a multimeter to the TP1 (-) and TP2 (+) test points (3 and 2, respectively; see figure 2-3) of battery power supply A3. A value of at least 10 volts shall be measured. If the battery voltage is low, the battery pack may need charging. Proceed to the following step.

m. Slide battery power supply A3 into the standard and secure it with the four front knurled-head captive fasteners.

n. Connect the ac line cord at the rear of the standard (figure 2-2) to a 115 volt ac power source.

o. Allow 16 hours (maximum) for the charging in the MANUAL HIGH mode. A 24 hour charge time is recommended for the AUTO mode.

p. At the end of the charge period, position the battery charging mode switch to AUTO and then to MANUAL LOW, observe the CIRCUIT CHECK meter with the CIRCUIT CHECK switch in the BTRY CHG position. The meter should read approximately 0.5 or less.

q. If the meter reading is between 4 and 5 in the AUTO mode, it is possible that there are shorted cells in the battery pack and the pack must be replaced. In the event that a new battery pack is not available, position the charging mode switch to MANUAL LOW. This will not cause any harm to the system or battery.

NOTE

To ensure an accurate reading of battery voltage, remove ac power from the standard prior to taking the measurement.

r. Place the CIRCUIT CHECK switch (5, figure 2-1) on the front of the standard in the BTRY V position. The CIRCUIT CHECK meter (6) should read a value of 8.5 to 9.5; if not, institute troubleshooting procedures in table 5-6 (last procedure of the Preliminary Set-Up).

s. Reapply power to the standard and allow warmup.

t. Place the CIRCUIT CHECK switch to the BTRY CHG position.

u. Place the BATTERY CHARGE switch to the MANUAL LOW position. The CIRCUIT CHECK meter should read +0.2 to +0.5; if not, institute troubleshooting procedures in table 5-6 (last procedure of Preliminary Set-Up).

v. Place the BATTERY CHARGE switch to the MANUAL HIGH position. The CIRCUIT CHECK meter should read +4 to +5; if not institute troubleshooting procedures in table 5-6 (last procedure of Preliminary Set-Up).

w. Place the BATTERY CHARGE switch to the AUTO position. The CIRCUIT CHECK meter should read approximately between 5 to 0.5 depending upon the state of charge; however, if the battery were charged for 24 hours, the meter indication should be approximately 0.5; if not, institute troubleshooting procedures in table 5-6 (last procedure of Preliminary Set-Up).

4-6. SCHEDULED PERFORMANCE TEST. To comply with scheduled performance testing, proceed as follows:

NOTE

An ac power outlet providing 115 volts, 60 Hz, and an appropriate dc power supply must be available to perform the following procedures.

a. Connect the ac line cord at the rear of the standard to an ac power source.

b. Connect a +22 to +30 volt external dc power source to the A1A3J1 connector (8, figure 2-2) at the rear of the standard.

NOTE

If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: 0-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C, or Verdin RF Transmission.

c. Connect a calibrated reference signal source to the 5 MHz IN connector (7, figure 2-1) at the front of the standard. This precision signal is used as a phase lock reference input.

d. Connect 50 ohm terminations at the 5 MHz OUT, 1 MHz OUT, and 100 KHz OUT connectors (13, 14, and 15 figure 2-1) at the front of the standard.

e. Place the BATTERY CHARGE switch (17, figure 2-1) on the front of the standard to the AUTO position.

f. Place the 1 MHz REF switch (7, figure 2-2) to the SINE position.

g. Place the SYNC MODE switch (10, figure 2-1) to the CONT position.

h. Turn on the external ac and dc power sources connected in steps a and b, above.

i. Allow a 1 hour warmup period for the standard.

j. Perform steps c through g of the Preliminary Setup procedure in table 2-2. If the correct value is not observed on the CIRCUIT CHECK meter for any setting of the CIRCUIT CHECK switch, institute troubleshooting procedures in table 5-7.

k. Temporarily disconnect the primary frequency standard 5 MHz, 1 volt input from the 5 MHz IN connector at the front of the standard. The UNLOCK indicator (11, figure 2-1) at the front of the standard should be illuminated; if not, institute troubleshooting procedures in table 5-7.

l. Reconnect the primary frequency standard 5 MHz input to the 5 MHz IN connector. The UNLOCK indicator should still be illuminated; if not, institute troubleshooting procedures in table 5-7.

m. Press the RESET pushbutton switch (16) on the front of the standard. The UNLOCK indicator should be extinguished if the system has been locked; if not, institute troubleshooting procedures in table 5-7.

n. Disconnect the primary frequency standard 5 MHz input from the 5 MHz IN connector.

o. Connect a primary frequency standard 1 MHz sine wave with an amplitude of at least 1 volt to the J3, 1 MHZ/1 PPS IN connector (6, figure 2-2) at the rear of the standard.

p. Repeat step m.

q. Connect a primary frequency standard 1 PPS, 1 volt or more pulse train to the 1 PPS IN connector (12, figure 2-1) at the front of the standard. The SYNC indicator (8) should flash with an on period that is longer than the off period; if not, institute troubleshooting procedures in table 5-7.

r. Remove 50 ohm terminations and connect standard inputs and outputs.

4-7. BATTERY SWITCHOVER CHECK. To perform the battery switchover check, proceed as follows:

NOTE

An ac outlet providing 115 volts, 60 Hz and an appropriate dc power supply must be available to perform the following procedures.

a. Connect the ac line cord at the rear of the standard (figure 2-2) to a 115 volt ac power source.

b. Connect a +22 volt to +30 volt external dc power source to the A1A3J1 connector (8, figure 2-2) at the rear of the standard.

NOTE

If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards, another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C, or Verdin RF Transmission.

c. If a calibrated reference signal source is available, lock the standard with a 5 MHz or 1 MHz external reference in accordance with the procedure in the Preliminary Setup , Step i(1) of table 2-2. If a primary frequency is not available, go to step e.

d. Place the CIRCUIT CHECK switch (5, figure 2-1) at the front of the standard to the MEM V position. The CIRCUIT CHECK meter (6) should read between 4 and 6; if not, institute troubleshooting procedures in table 5-6.

e. If no calibrated reference signal source is available, place the CIRCUIT CHECK switch to the 5 MHz position, instead of the MEM V position. The CIRCUIT CHECK meter (6, figure 2-1) should read +6 to +10; if not, institute troubleshooting procedures in accordance with table 5-6.

f. Disconnect the ac line cord from the 115 volt ac power source. The CIRCUIT CHECK meter should again read between 4 and 6; if not, institute troubleshooting procedures in table 5-6.

g. If an external source of ac power is not connected, proceed to step k; if it is, continue with step h.

h. Place the CIRCUIT CHECK switch to the DC IN position. The CIRCUIT CHECK meter should read between 7 and 10; if it doesn't, institute troubleshooting procedures in accordance with table 5-6.

i. Place the CIRCUIT CHECK switch to MEM V position.

j. Turn off the external +22 to +30 volt dc power source. The remote alarm and/or status indicator connected to the cable at the A1A3J1 connector should indicate an alarm condition; if not, institute troubleshooting procedures in table 5-6.

k. With the CIRCUIT CHECK switch still in the MEM V position, observe the CIRCUIT CHECK meter. A value between 4 and 6 should be observed; if not, institute troubleshooting procedures in table 5-6.

4-8. BATTERY PACK REPLACEMENT. To replace the batteries in battery power supply A3, proceed as follows:

a. Loosen the four knurled-head screws that secure the front of battery power supply A3 to the standard, using a flat-head screwdriver.

b. Slide battery power supply A3 out of the standard.

c. Place ON/OFF switch S1 (figure 2-3) to the OFF position.

d. Remove and retain the 10 Phillips screws that secure the top cover of the battery power supply.

e. Remove the top cover of the battery power supply.

f. Loosen (do not remove) the four Phillips screws (two on each side) that secure the two brackets that hold the battery pack in place.

g. Disconnect the battery pack connector by pulling the connector upward, and away from the printed circuit board.

h. Lift the battery pack out of the battery power supply.

i. Install the replacement battery pack in the battery power supply.

j. Hold each of the brackets that hold the battery pack in place, in turn, against the battery pack and tighten the associated Phillips screws to secure the bracket.

k. Plug the battery pack connector into the mating connector on the printed circuit board.

l. Install the top cover of the battery power supply and secure it with the 10 Phillips screws.

m. Place the ON/OFF switch at the rear of battery power supply A3 in the ON position.

n. Slide battery power supply A3 into the standard and secure it by tightening the four front knurled-head captive fasteners.

o. Make certain that the BATTERY CHARGE switch (17, figure 2-1) on the front of the standard is in the AUTO position.

p. Recheck battery after 24 hours and repeat paragraph 4-5.

4-9. PERFORMANCE VERIFICATION TEST. Perform the tests described in the following subparagraphs to verify that the standard is operating properly.

a. Test Equipment Required. Refer to table 1-7 for a list of test equipment required to perform the verification test.

b. Preliminary Setup. Before initiating the verification tests, perform the following steps:

NOTE

An ac outlet providing 115 volts, 60 Hz and an appropriate dc power supply must be available to perform the following procedures.

(1) Connect the ac line cord to a 115 volt ac power source.

(2) Place the BATTERY CHARGE switch (17, figure 2-1) on the front of the standard to the AUTO position.

(3) Turn on the 115 volt ac power source and allow at least 24 hours for warmup.

c. 5 MHz Frequency Adjust Range Check. Test the frequency and amplitude of the 5 MHz outputs of the standard as follows:

(1) Set a frequency counter (Refer to table 1-7) to operate in the 10 second gate mode.

(2) Using the frequency counter, measure the frequency of the output at the 5 MHz, J1 connector (3, figure 2-2). The frequency should be 5 MHz $\pm$0.1 Hz; if not, institute troubleshooting procedures in accordance with table 5-8.

(3) Record the frequency read in step (2) on the Installation Standard Summary Sheet.

NOTE

If a calibrated reference signal source is not available, the COARSE ADJUST control should not be altered.

(4) Remove the protective cap from the COARSE ADJUST control (1, figure 2-1) at the front of the standard.

(5) Using a flat-head screwdriver, position the COARSE ADJUST control fully clockwise.

(6) Record the frequency measured by the frequency counter with that setting of the COARSE ADJUST control.

(7) Position the COARSE ADJUST control to the fully counterclockwise position.

(8) Record the frequency measured by the frequency counter with that setting of the COARSE ADJUST control.

(9) Return the COARSE ADJUST control to the setting that produces the reading recorded in step (3), above.

(10) Calculate the difference between the values recorded in steps (6) and (8). If the difference is more than 0.5 Hz, institute troubleshooting procedures in accordance with table 5-8.

(11) Disconnect the frequency counter from the 5 MHz, J1 connector.

(12) Connect an RF voltmeter to the 5 MHz, J1 connector, with the connector terminated in 50 ohms. The signal level read on the RF voltmeter shall be greater than 1.0 volt rms; if not, institute troubleshooting procedures in accordance with table 5-8.

(13) Replace protective cap upon completion of procedure.

d. 1 MHz Output Test. Test the frequency and amplitude of the 1 MHz outputs of the standard as follows:

(1) Set a frequency counter (refer to table 1-7) to operate in the 10 second gate mode.

(2) Using a frequency counter, measure the frequency of the output at the 1 MHz, J2 connector (2, figure 2-2) at the rear of the standard. The frequency read shall be 1 MHz ±0.1 Hz; if not, institute troubleshooting procedures in accordance with table 5-8.

(3) Disconnect the frequency counter from the 1 MHz, J2 connector.

(4) Connect an RF voltmeter to the 1 MHz, J3 connector, with the connector terminated in 50 ohms. The signal level read on the RF voltmeter shall be greater than 1.0 volt rms; if not, institute troubleshooting procedures in accordance with table 5-8.

e. 100 KHz Squarewave Output Test. Test the frequency and amplitude of the 100 KHz outputs of the standard as follows:

(1) Using a frequency counter, measure the frequency of the output at the 100 KHz, J3 connector (1, figure 2-2). The frequency shall be 100 KHz ±0.1 Hz.

(2) Disconnect the frequency counter from the 100 KHz, J3 connector.

(3) Connect an oscilloscope to the 100 KHz, J3 connector with the connector terminated in 50 ohms. The signal level observed on the oscilloscope shall be greater than 1.0 volt peak-to-peak; the waveform observed shall be a square wave with no overshoots or undershoots greater than 10 percent of peak-to-peak amplitude; the positive half cycles within ±10 percent. If not, institute troubleshooting procedures described in table 5-8.

f. 1 PPS Output Test. Test the frequency and waveshape of the 1 PPS outputs of the standard as follows:

(1) Connect an oscilloscope to the J1 1 PPS OUT connector (4, figure 2-2) at the rear of the standard with the connector terminated in 50 ohms.

(2) Observe that the waveform which appears on the oscilloscope has the following characteristics; if not, institute troubleshooting procedures described in table 5-8.

(a) Repetition rate = 1 PPS

(b) Pulse width = 20 microseconds ±1.0 microsecond

(c) Amplitude = 4.7 volts peak-to-peak ±10%

(d) Rise time = less than 10 nanoseconds

g. 1 MPPS Output Test. Test the characteristics of the 1 MPPS outputs of the standard as follows:

(1) Connect an oscilloscope to the J2, 1 MPPS OUT connector (5, figure 2-2) with the connector terminated in 50 ohms.

(2) Observe that the waveform that appears on the oscilloscope has the following characteristics; if not, institute troubleshooting procedures described in table 5-8.

(a) Repetition = 1 MPPS

(b) Pulse width = 0.8 microsecond

(c) 3.4 volts peak-to-peak (1.2 volts rms) into 1000 ohms

(d) Disconnect 5 MHz input

h. 1 PPS Synchronization Test. Test the synchronization of the standard with an externally applied 1 PPS synchronizing input as follows:

NOTE

If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt RMS and an output frequency of 5 MHz or 1 MHz, all procedures called out in this technical manual should be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C, or Verdin RF Transmission.

(1) Adjust the appropriate calibrated reference signal source for 1 PPS, 1 volt peak-to-peak (or more) amplitude, 5 microseconds (or more) pulse width, and 100 nanoseconds rise time.

(2) Connect the calibrated reference signal source output to the 1 PPS IN connector (12, figure 2-1) at the front of the standard.

(3) Place the SYNC MODE switch (10) to the CONT position.

(4) Observe the SYNC indicator (8) to ensure that it flashes with a longer on time than off time; if not, institute troubleshooting procedures in table 5-8.

(5) Connect one channel of a dual trace oscilloscope (See table 1-7) to the output of the frequency source and the other channel to the 1 PPS OUT connector at the front of the standard. There should be less than 200 nanoseconds delay between the latter channel waveform and the former channel waveform; if not, institute troubleshooting procedures described in table 5-8.

i. Phase Lock Characteristics Test. Test the varied phase locking characteristics of the standard listed below:

(1) 5 MHz Phase Lock Test. Perform the 5 MHz phase locking characteristics test as follows:

(a) Place the TIME CONSTANT switch (2, figure 2-1) on the front of the standard in the SHORT position.

(b) Connect the 5 MHz output from the calibrated reference signal source, of 1 volt peak-to-peak (or more) to the 5 MHz IN connector (16) at the front of the standard. Allow sufficient time for the system to lock. (Reference table 2-2, step i.)

(c) Place the CIRCUIT CHECK switch (5) at the front of the standard to the LOCK INDICATOR position. The CIRCUIT CHECK meter (6) should indicate 0 and the UNLOCK indicator (11) should be extinguished following the pressing of the RESET pushbutton (16); if either indication is incorrect, adjust the frequency in accordance with Preliminary Setup instructions in step i, (procedures 1 through 9) in table 2-2. Remove the 5 MHz signal source connection.

(2) 1 MHz Phase Lock Test. Perform the 1 MHz phase locking test as follows:

(a) Place the TIME CONSTANT switch (2, figure 2-1) on the front of the standard in the SHORT position.

(b) Connect the 1 MHz output from the calibrated reference signal source at an amplitude of 1 volt peak-to-peak (or more), to the 1 MHz/1 PPS IN connector, J3, (6, figure 2-2) with the 5 MHz output disconnected.

(c) Place the CIRCUIT CHECK switch (5, figure 2-1) at the front of the standard to the LOCK INDICATOR position. The CIRCUIT CHECK meter (6) should indicate 0 and the UNLOCK indicator (11) should be extinguished following the pressing of the RESET pushbutton (16); if either indication is incorrect, adjust the frequency in accordance with the Preliminary Setup instructions in step i, (procedures 1 through 9) in table 2-2.

(3) UNLOCK Indicator Test. Perform the UNLOCK indicator test as follows:

(a) The unlock indicator test has actually been performed by accomplishment of the procedures called out in paragraphs 4-9, i, (1) and (2). Assuming that the UNLOCK indicator is extinguished after pressing the RESET pushbutton, as specified in step (c) above, no further testing is required. If the UNLOCK indicator remains illuminated, perform steps (b) and (c).

(b) If the phase lock loop remains locked as indicated by the illuminated UNLOCK indicator, institute troubleshooting procedures in table 5-8.

(c) Disconnect the 5 MHz or the 1 MHz calibrated reference signal source and observe the UNLOCK indicator. It should be illuminated; if not, institute troubleshooting procedures in table 5-8.

(d) Observe the CIRCUIT CHECK meter. In the LOCK position, the meter reading should be between +6 and +9; if not, institute troubleshooting procedures in table 5-8.

(4) Memory Operation Test. Perform the memory operation test as follows:

(a) Apply the 5MHz output of a primary frequency standard to the 5 MHz IN connector (7, figure 2-1) at the front of the standard.

(b) Place the CIRCUIT CHECK switch (5) to the LOCK INDICATOR position.

(c) Observe the CIRCUIT CHECK meter (6). If it is not fixed at the 0 value, adjust the COARSE ADJUST control (1) with a flat-head screwdriver to stop the sweeping of the meter at 0.

(d) Place the CIRCUIT CHECK switch MEM V position.

(e) Observe the CIRCUIT CHECK meter (6). If it is not reading +5, adjust the COARSE ADJUST control to achieve that reading.

(f) Disconnect the primary frequency standard 5 MHz from the standard.

(g) Observe the CIRCUIT CHECK meter. The reading should be +5; if not, institute troubleshooting procedures in table 5-8.

j. External Dc Power Operation Test. If external dc is applied, perform the dc power operation test as follows:

(1) Remove ac power from the standard.

(2) Repeat the performance verification tests specified in 4-9, steps a through i. If the required results cannot be obtained, institute troubleshooting procedures in table 5-8.

(3) Reconnect ac power upon completion of test and allow for warmup unless step k is to be performed immediately following.

k. Battery Operation Test. Perform the battery test as follows:

(1) Disconnect the ac line cord from the ac power source.

(2) Disconnect the external dc power source from A1A3J1; (8, figure 2-2) at the rear of the standard.

(3) Repeat the performance verification tests in subparagraphs a through i. If the required results cannot be obtained, institute troubleshooting procedures in table 5-8.

CHAPTER 5

TROUBLESHOOTING

5-1. INTRODUCTION. This chapter contains instructions for procedures that can be used to isolate faults in the operation of the standard to a defective module and, when applicable, major assembly in a module. Reference data and troubleshooting diagrams are provided as are procedures for the performance of these fault isolation actions. Wherever possible, fault isolation procedures are performed using front panel controls and indicators as a starting point for trouble localization.

NOTE

When performing troubleshooting procedures, it is advisable to keep the standard connected to an external ac or dc power source while replacing power supply A2 or battery power supply A3. If assemblies in rf oscillator A1 are being replaced, reinstall rf oscillator A1 in the standard as soon as the assembly replacement procedure has been completed.

5-2. TROUBLESHOOTING INDEX. Table 5-1 provides a listing of references to procedure paragraphs and diagrams in this technical manual that can be used to troubleshoot the standard when a specific function (output signal) is defective.

Table 5-1. Troubleshooting Index

Functional Area	Trouble-shooting Table	Trouble-shooting Diagram	Functional Description Paragraph	Alignment/ Adjustment Paragraph
5 MHz output	5-6	5-1	3-3a(1) and (5)	2-4b
1 MHz output	5-6	5-1	3-3a (5)	-
100 KHz output	5-6	5-1	3-3a (5)	-
1 PPS output	5-7	5-2	3-3a(4)(a)	-
1 MPPS output	5-8	5-2	3-3a(4)(c)	-
Synchronization	5-7	5-2	3-2d	-
Phase lock input	5-6	5-1	3-2b	-
Alarm functions	5-8	5-4(sheet 2 of 3)	3-2f and 3-3a(3)	-

5-3. RELAY AND LAMP INDEXES. Table 5-2 is an index of the relays in the standard and table 5-3 is an index of the lamps in the standard.

5-4. PROTECTIVE DEVICE INDEX. Table 5-4 provides a list of the fuses in the standard.

5-5. MAINTENANCE TURN-ON PROCEDURE. Table 5-5 is a maintenance turn-on procedure that describes the energizing of the standard from the fully de-energized condition to full operation.

Table 5-2. Relay Index

Reference Designation	Functional Name	Energizing Voltage	Troubleshooting Diagram (Fig. No.)
A1A2A1K1	Loop time constant relay	+15V dc	5-3
A1A3A3K1	External dc operation relay	+22V dc	5-4

Table 5-3. Lamp Index

Reference Designation	Functional Name	Energizing Voltage	Troubleshooting Diagram (Fig. No.)
A1A6DS1	AC (LED) indicator	+22V dc	5-7, 5-12
A1A4DS1	UNLOCK (LED) indicator	+5V dc	5-5
A1A4DS2	SYNC (LED) indicator	+5V dc	5-5

Table 5-4. Protective Device Index

Reference Designation	Front Panel Marking	Rating Volts	Rating Amps	Circuit Protected	Troubleshooting Diagram (Fig. No.)
A2F1	0.5 SLO BLO	250	0.5	Ac power supply	5-8
A3F1*	-	250	3	Battery power supply	5-9
A3F2*	-	250	3	Battery power supply	5-9

*A3F1 and A3F2 are mounted at rear of battery power supply A3. Battery power supply A3 must be disassembled for access to these fuses.

Table 5-5. Maintenance Turn-On Procedure

Procedure	Normal Results	If Results are Abnormal
1. Place BATTERY CHARGE switch to AUTO at front of standard.	-	-
2. Place 1MHZ REF switch to SINE at rear of standard.	-	-
3. Place SYNC MODE switch to SYNC at front of standard.	-	-
4. Connect ac line cord to 115V ac power source.	AC indicator is illuminated.	Replace power supply A2.
5. Connect external dc source to A1A3J1 connector at rear of standard.	CIRCUIT CHECK meter reads between 7 and 10 with CIRCUIT CHECK switch in DC IN position.	Replace power converter A1A3.
6. Remove battery power supply A3 and place ON/OFF switch on rear of that module to ON position. Re-install the module.	CIRCUIT CHECK meter reads between 6 and 10 with CIRCUIT CHECK switch in BTRY V position. Place CIRCUIT CHECK switch to BTRY CHG position. Meter reading should be between 0.5 and 5.	Check for defective battery power supply A3 or battery charger A2A1 PC card (inside A2 module). Replace defective module or PC card.
7. Place battery charge switch at front panel from AUTO to MANUAL LOW position.	CIRCUIT CHECK meter should read between 0.2 and 0.5.	Check defective battery charger A2A1 PC card (inside A2 module). Replace defective module or PC card.
8. Place battery charge switch at front panel from MANUAL LOW to MANUAL HIGH position.	CIRCUIT CHECK meter should read from 4 to 5.	Check defective battery charger A2A1 PC card (inside A2 module). Replace defective module or PC card.

5-6. TROUBLESHOOTING PROCEDURES. Equipment faults may become evident during the performance of Preliminary Setup procedures in table 2-2, the Scheduled Performance test in paragraph 4-6, or the Performance Verification Test in paragraph 4-9. When a fault symptom is observed, the troubleshooting data referenced in paragraphs 5-2, 5-3, and 5-4; troubleshooting diagrams referenced in paragraph 5-7, the fault logic diagrams in figures 5-1 and 5-2; or troubleshooting charts in tables 5-6, 5-7 and 5-8 can be used as aids in locating the source of the trouble. When using tables 5-6, 5-7 and 5-8, find the symptom description that has been observed during the Preliminary Setup, Scheduled Performance, or Performance Verification Test in the Trouble column. The most probable cause of trouble and the remedy are listed in the applicable columns. When replacement procedures are called for, refer to the applicable subparagraph in paragraphs 6-5 through 6-12.

Table 5-6. Troubleshooting

Procedure	Trouble	Probable Cause	Remedy
Preliminary Setup	CIRCUIT CHECK meter does not read from +6 to +10 with CIRCUIT CHECK switch in REF INPUT 5MHZ or 1MHZ position (table 2-2, step f).	Defective A1A4 assembly	Replace A1A4
	CIRCUIT CHECK does not read from +6 to +10 with CIRCUIT CHECK switch in 100KHZ position (table 2-2, step f).	Defective A1A1 or A1A5 assembly	Check for reading between +6 and +10 on CIRCUIT CHECK meter with switch in 1MHz and 5MHZ positions. If observed, replace A1A5; if not, replace A1A1.
	CIRCUIT CHECK meter does not read from +6 to +10 with CIRCUIT CHECK switch in 1MHZ position (table 2-2, step f).	Defective A1A5 assembly	Replace A1A5.
	CIRCUIT CHECK meter does not read from +6 to +10 with CIRCUIT CHECK switch in 5MHZ position (table 2-2, step f).	Defective A1A5 assembly	Replace A1A5.
	CIRCUIT CHECK meter does not read from +1 to +9 with standard phase locked or either 0 or 10 with standard not locked and CIRCUIT CHECK switch in MEM V position (table 2-2, step f).	Defective A1A4 assembly	Replace A1A4.

Table 5-6. Troubleshooting (Continued)

Procedure	Trouble	Probable Cause	Remedy
Preliminary Setup (Continued)	CIRCUIT CHECK meter does not read fixed 0 value with standard phase locked and CIRCUIT CHECK switch in LOCK INDICATOR position (table 2-2, step f).	Adjustment required or defective A1A4 assembly	Adjust in accordance with paragraph 2-4b; if trouble persists, replace A1A4.
	CIRCUIT CHECK meter does not read from +6 to +9 with no phase lock reference input applied and CIRCUIT CHECK switch in LOCK INDICATOR position (table 2-2, step f).	Defective A1A4 assembly	Replace A1A4.
	CIRCUIT CHECK meter does not read from +4 to +10 with CIRCUIT CHECK switch in OUTER OVEN position (table 2-2, step f).	Defective A1A1 assembly	Replace A1A1.
	CIRCUIT CHECK meter does not read from +6 to +10 with CIRCUIT CHECK switch in INNER OVEN position (table 2-2, step f).	Defective A1A1 assembly	Replace A1A1.
	CIRCUIT CHECK meter does not read from +7 to +10 with CIRCUIT CHECK switch in DC IN position. (See note below and table 2-2, step f.) NOTE The 7 to 10 volt reading applies only if external dc is connected; if not, reading will be 0.	Defective A1A3 assembly	Replace A1A3.
	CIRCUIT CHECK meter does not read from +2 to +4 with CIRCUIT CHECK switch in REG V position (table 2-2, step f).	Defective A1A3 assembly	Replace A1A3.

Table 5-6. Troubleshooting (Continued)

Procedure	Trouble	Probable Cause	Remedy
Preliminary Setup (Continued)	CIRCUIT CHECK meter does not read from +6 to +10 with CIRCUIT CHECK switch in BTRY V position. (table 2-2, step f). NOTE When ac power is applied to the standard, a measurement of the battery voltage will be a combination of battery voltage and battery charging voltage. To read only the battery voltage under load conditions disconnect the ac power to the standard. The CIRCUIT CHECK meter should read between +6 and +10.	Battery pack in A3 discharged, or defective A3 module	No battery voltage reading: a) ON/OFF switch at A3 is defective. Replace A3. b) Fuses inside A3 (Ref. Fig. 5-9) are blown. Replace fuses. If battery voltage reads low, allow battery to recharge in accordance with paragraph 4-5.
	CIRCUIT CHECK meter does not read correct value for any setting of BATTERY CHARGE switch with CIRCUIT CHECK switch in BTRY CHG position. (Table 2-2, step f; paragraph 4-5, steps u, v and w and note below.)	Defective A2A1 assembly	Replace A2A1 or A2 module.

NOTE

The battery module can be charged in three different modes as follows:

(1) AUTO mode - This is a constant voltage charge. Charging current is high when the battery voltage is low or in a discharged state. Charge current is low when battery voltage is high, or the battery is nearly fully charged. The CIRCUIT CHECK meter reading is therefore dependent on the state of the battery's condition and will read between 0.2 and 5.0. However, if the battery has been charged for more than 24 hours and the meter still reads high (4 to 5), there are two probable causes: (a) bad battery pack, replace with a new charging card A2A1. (b) bad charging circuit card A2A1, replace with a new charging card A2A1.

NOTE (Continued)

(2) MANUAL LOW Mode - This is a constant current charge at a rate of approximately 70 ma, independent of battery voltage. For a fully charged battery, this mode will keep the battery trickle-charged without losing its capacity. This position is safe; even if the battery pack has bad or shorted cells, it will not be damaged further.

(3) MANUAL HIGH Mode - This is also a constant current charge at a rate of approximately 650 ma, independent of battery voltage. This position is capable of charging a fully discharged battery pack in 16 hours. It must then be switched to the MANUAL LOW mode. CAUTION: If left in the MANUAL HIGH mode, the battery pack will over charge and damage may result.

Table 5-7. Troubleshooting

Procedure	Trouble	Probable Cause	Remedy
Scheduled Performance Test	UNLOCK indicator is not illuminated when 5 MHz phase lock reference input is disconnected. (Paragraph 4-6, step k.)	Defective UNLOCK indicator or A1A4 assembly	Replace UNLOCK indicator; if trouble persists, replace A1A4.
	UNLOCK indicator is extinguished when 5 MHz phase lock reference input is reconnected, but RESET pushbutton is not pressed. (Paragraph 4-6, step l.)	Defective A1A4 assembly	Replace A1A4.
	UNLOCK indicator is not extinguished when RESET pushbutton is pressed with 5 MHz phase lock reference input connected and phase lock system is locked. (Paragraph 4-6, step m.)	Defective RESET pushbutton or A1A4 assembly	Check continuity of RESET push-button. Replace if defective; if good, replace A1A4.
	SYNC indicator does not flash with longer on than off duty cycle when 1 PPS synchronizing input is connected. (Paragraph 4-6, step q.)	Defective SYNC indicator or A1A4 assembly	Replace SYNC indicator if it does not light at all; replace A1A4 if duty cycle is wrong.

Table 5-8. Troubleshooting

Procedure	Trouble	Probable Cause	Remedy
Performance Verification Test	Incorrect results observed in performance of 5 MHz output test. NOTE Refer to paragraph 4-9 for associated procedures	Defective A1A2, A1A1, or A1A5 assembly	Replace A1A5; if trouble persists, replace A1A1, and then, if still necessary, A1A2.
	Incorrect results observed in performance of 1 MHz output test.	Defective A1A5 assembly	Replace A1A5.
	Incorrect results observed in performance of 100 KHz squarewave output test.	Defective A1A5 assembly	Replace A1A5.
	Incorrect results observed in performance of 1 PPS output test.	Defective A1A4 assembly	Replace A1A4.
	Incorrect results observed in performance of 1 MPPS output test.	Defective A1A4 assembly	Replace A1A4.
	Incorrect results observed in performance of 1 PPS synchronization test.	Defective A1A4 assembly	Replace A1A4.
	Incorrect results observed in performance of phase lock characteristics test.	Defective A1A4 assembly	Replace A1A4.
	Incorrect results observed in performance of external dc power operation test.	Defective A1A3 assembly	Replace A1A3.
	Incorrect results observed in performance of battery operation test.	Defective battery pack, A3 module, or A2A1 assembly	Check and replace battery pack if defective; if not, replace A3 or A2A1.
Alarm Function	When ac power is applied, relay A1A3A3K1 energizes.	Bad relay	Replace A1A3 assembly.
	When ac power is disconnected, relay de-energizes.	Bad relay	Replace A1A3 assembly.

5-7. DIAGRAMS. Figures 5-1 and 5-2 are fault logic diagrams to be used as aids in troubleshooting the standard. Figures 5-3 through 5-12 are schematic diagrams of the modules and their assemblies. These schematic diagrams are furnished for reference purposes, only. This technical manual covers organizational level maintenance only. Repairs beyond module replacement are not described.

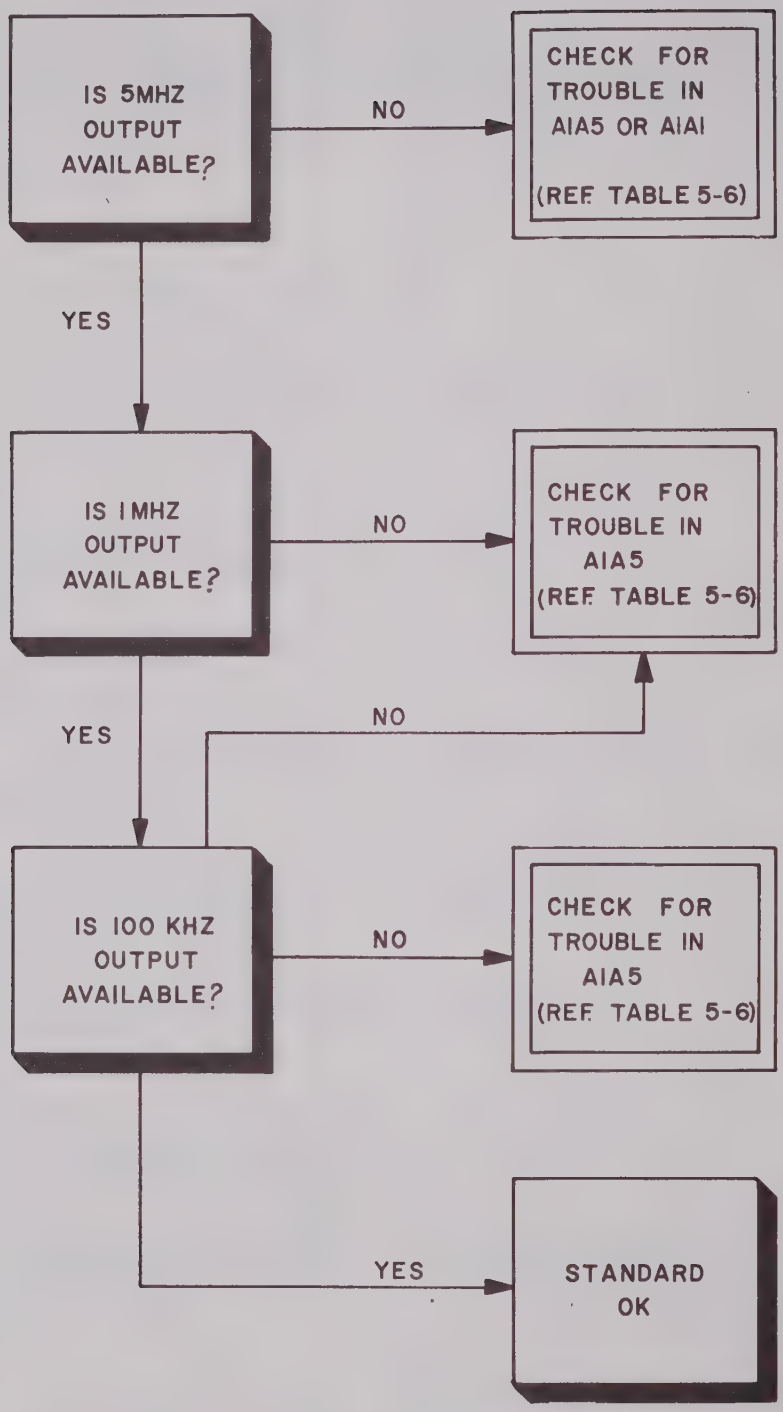


Figure 5-1. Analog Signal Fault Logic Diagram

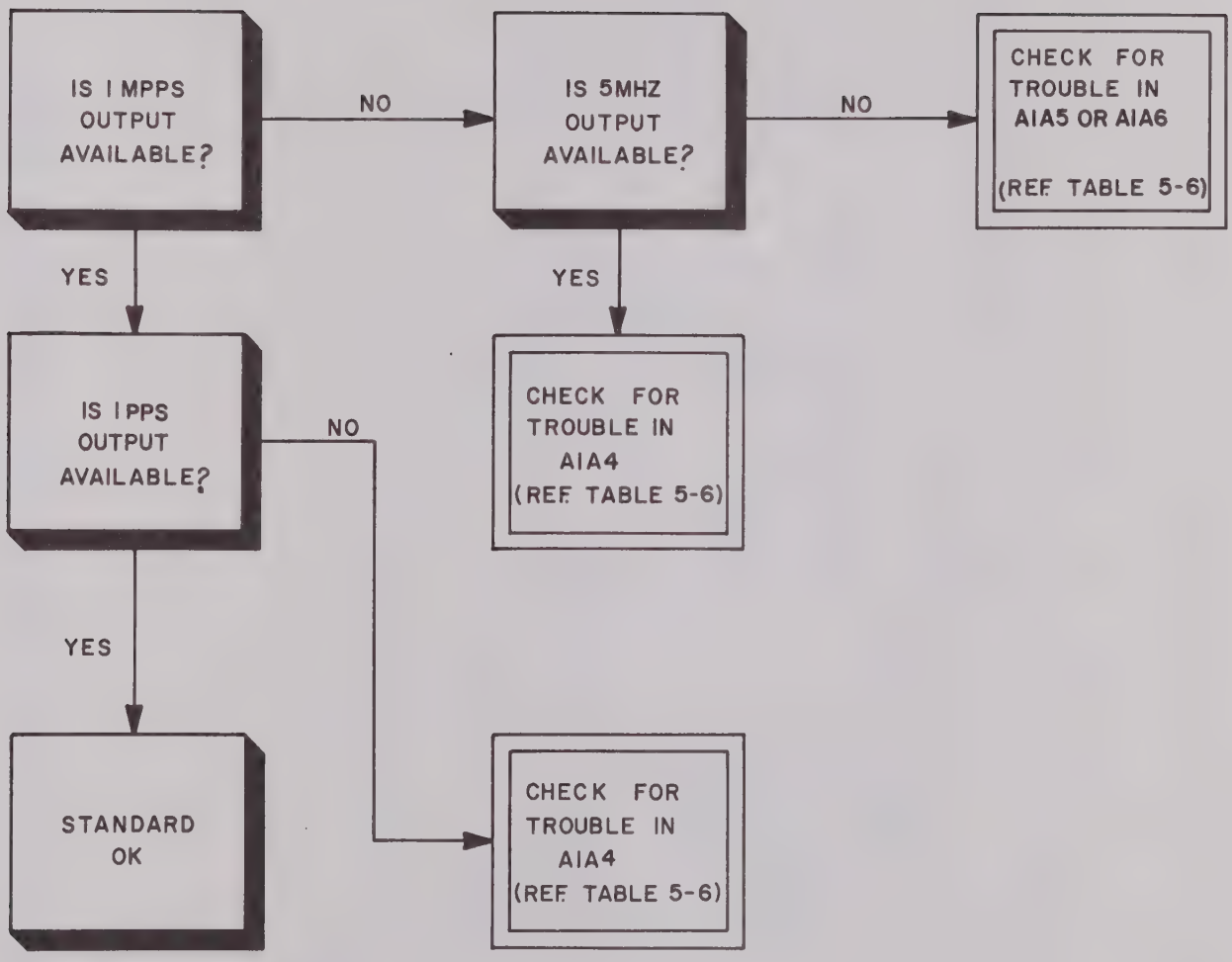
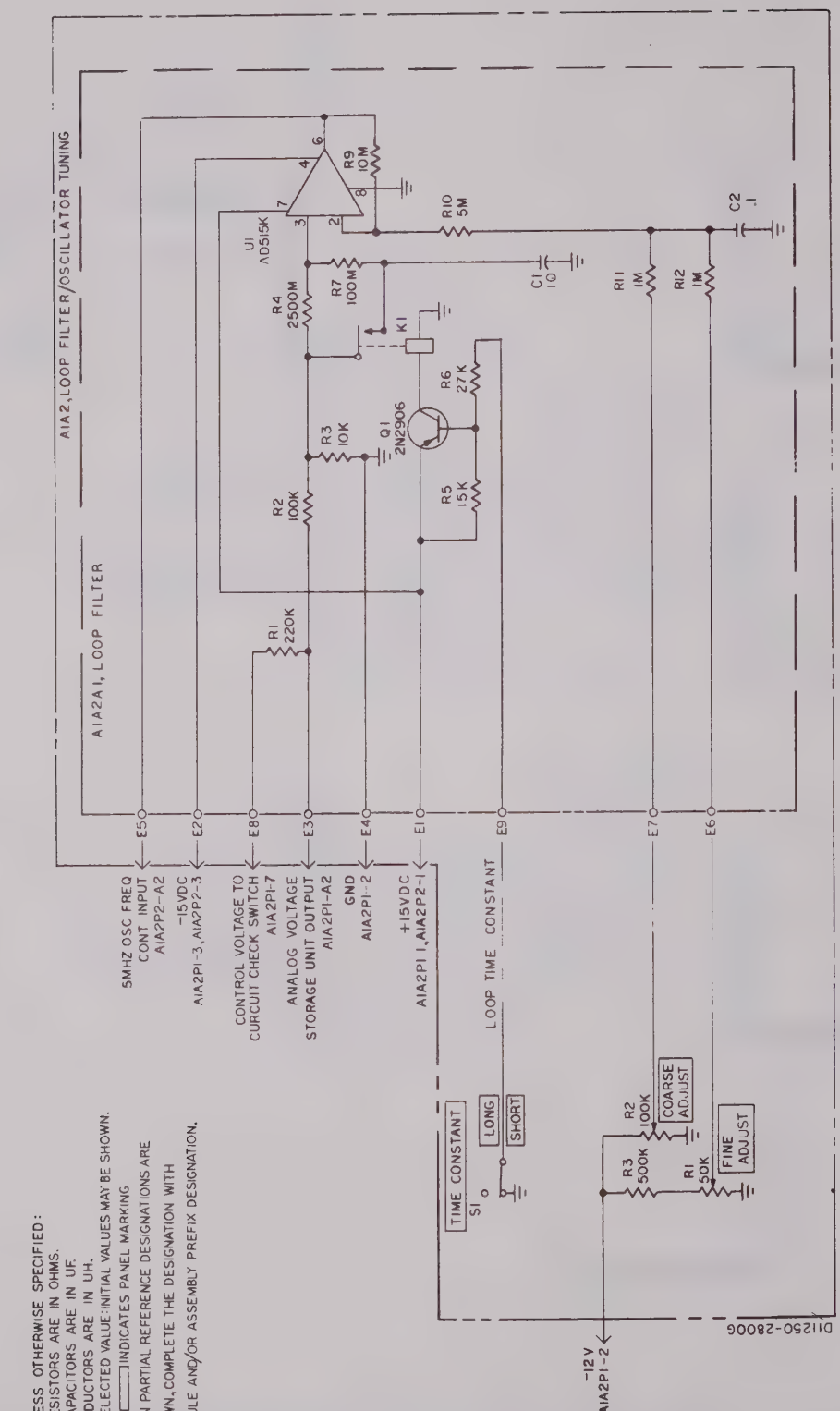


Figure 5-2. Digital Signal Fault Logic Diagram



NOTES:
A. UNLESS OTHERWISE SPECIFIED:
1. RESISTORS ARE IN OHMS.
2. CAPACITORS ARE IN UF.
3. INDUCTORS ARE IN UH.
B. #=SELECTED VALUE: INITIAL VALUES MAY BE SHOWN.
C. KEY: [ ] INDICATES PANEL MARKING
D. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION.

Figure 5-3. Loop Filter/Oscillator Tuning A1A2, Schematic Diagram

NOTES:
A. UNLESS OTHERWISE SPECIFIED
   1. ALL RESISTOR VALUES ARE IN OHMS
   2. ALL CAPACITORS ARE IN UF.
   3 ALL INDUCTORS ARE IN UH.
B. NOTED ITEMS ASSOCIATED WITH A1A3A1 HOUSING.
C. NOTED ITEMS ASSOCIATED WITH A1A3A2 HOUSING.
D. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION.

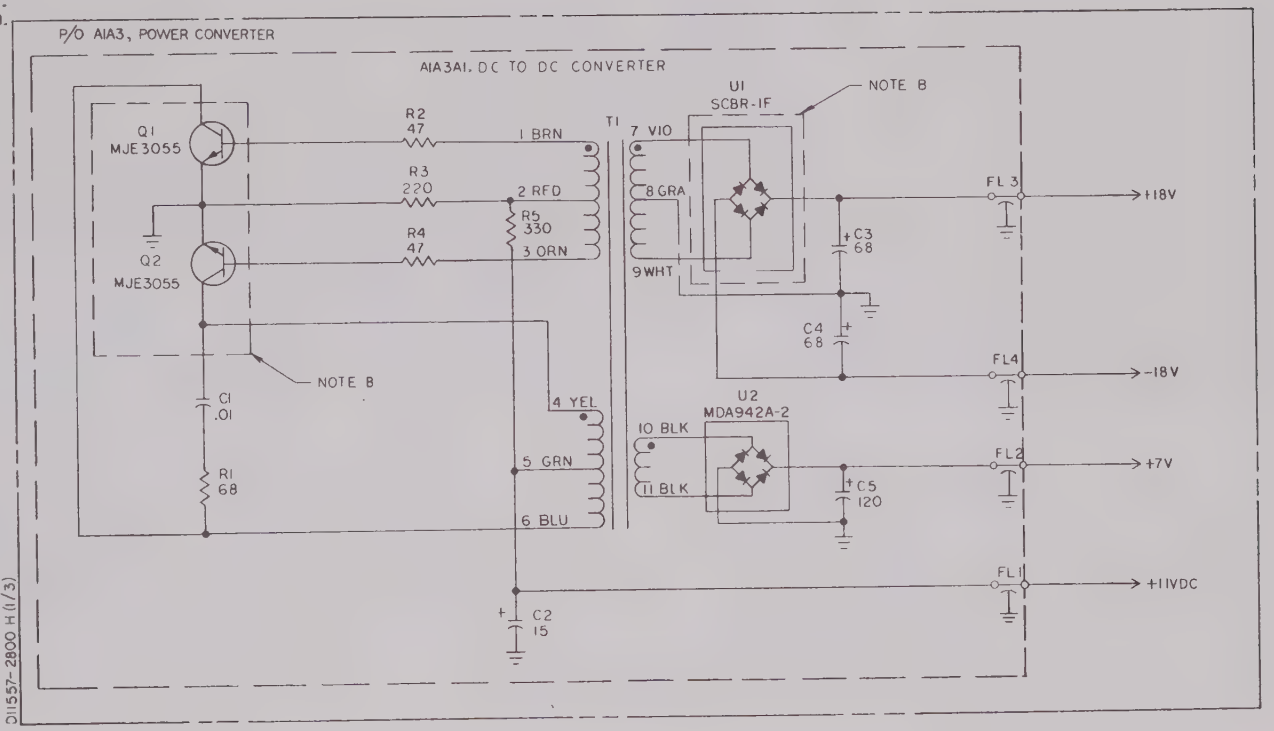


Figure 5-4. Power Converter A1A3, Schematic Diagram (Sheet 1 of 3)

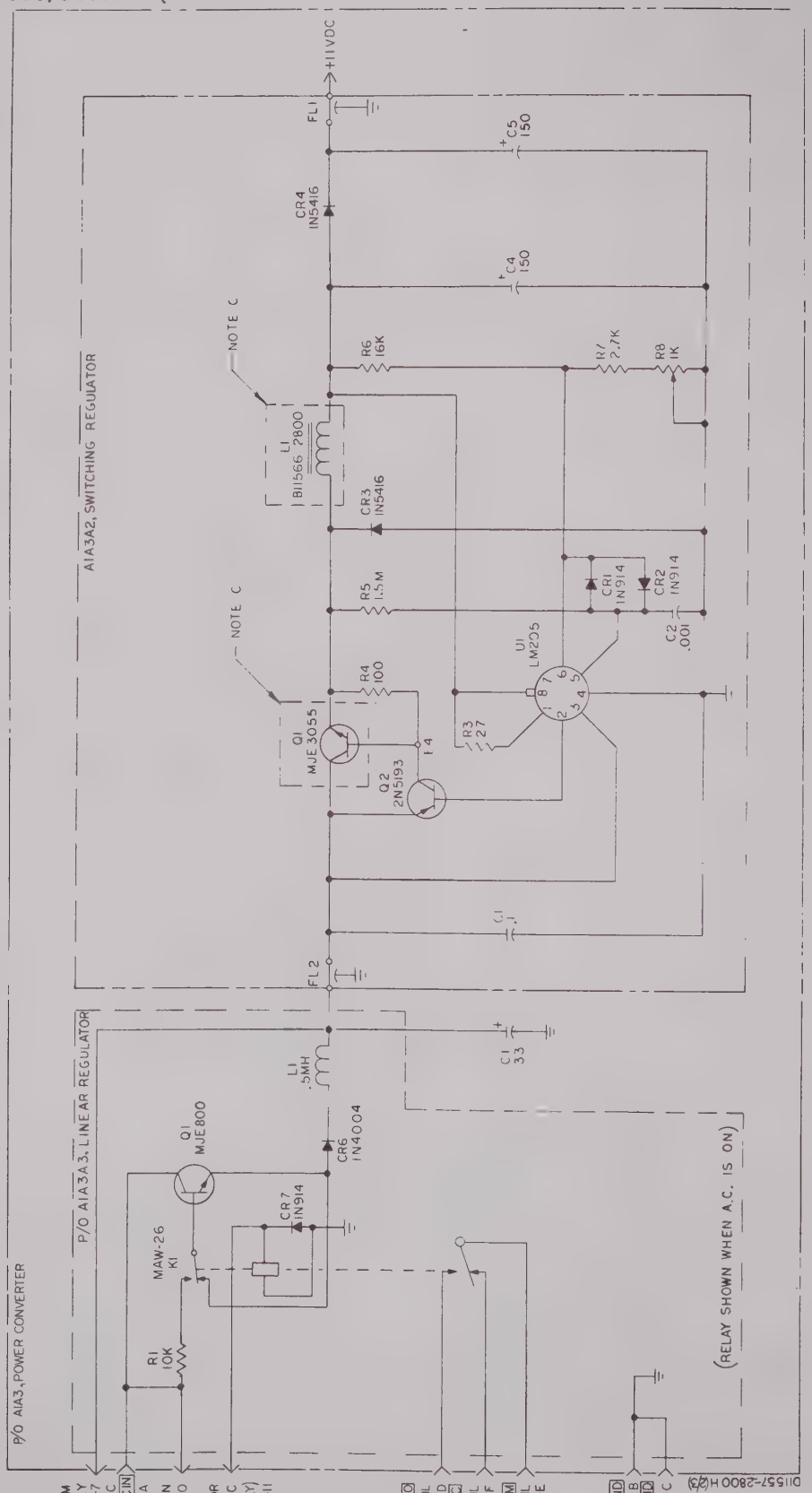


Figure 5-4. Power Converter A1A3, Schematic Diagram (Sheet 2 of 3)

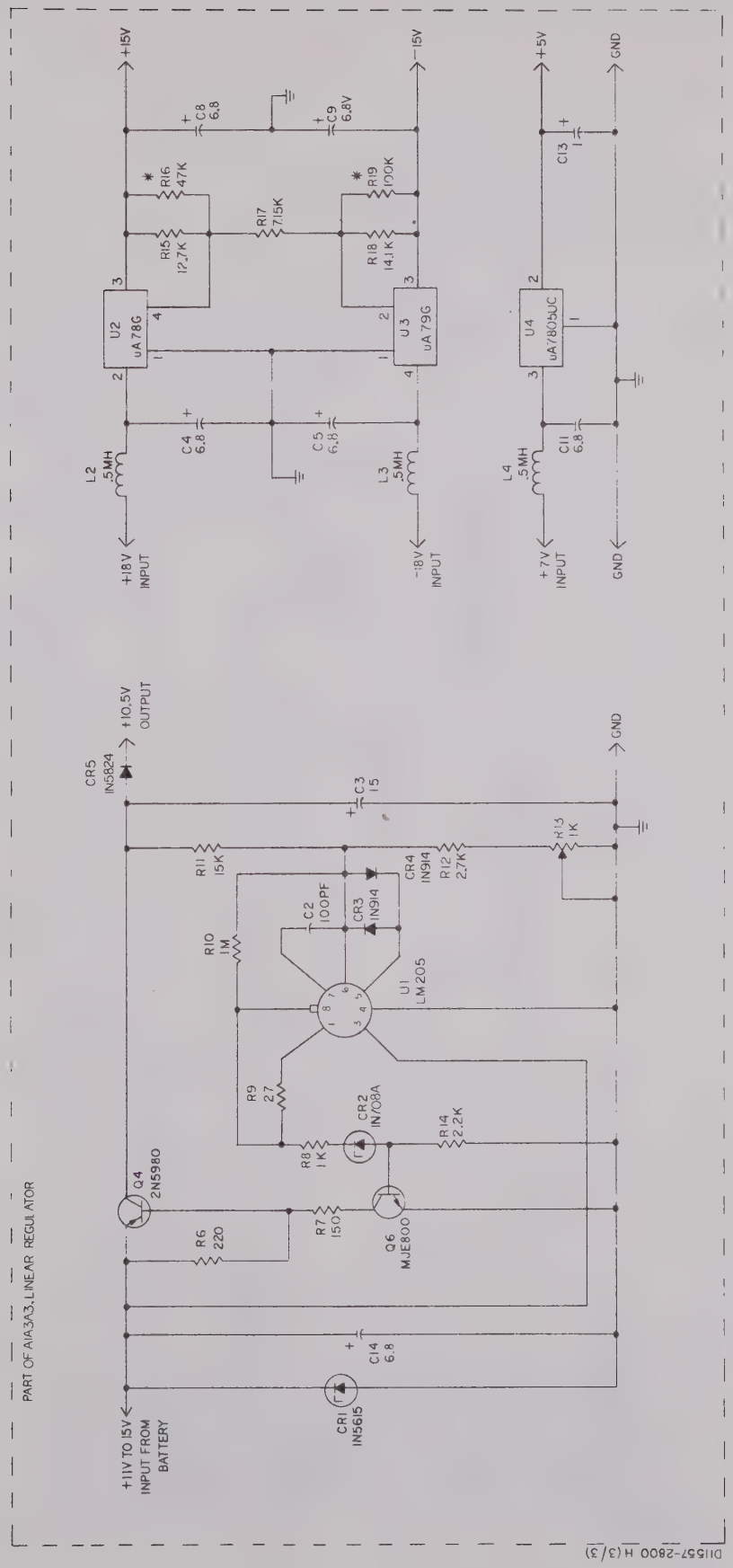


Figure 5-4. Power Converter A1A3, Schematic Diagram (Sheet 3 of 3)

NOTES:
A. UNLESS OTHERWISE INDICATED
1. ALL RESISTOR VALUES ARE IN OHMS
2. ALL CAPACITORS ARE IN UF.
3. ALL INDUCTORS ARE IN UH.
B. POWER CONNECTIONS:
1. A1A4A1
+5VDC = U1,U2,U12 PIN 14
+5VDC = U3 THRU U11 PIN 16
GND = U1,U2,U12 PIN 7
GND = U3 THRU U11 PIN 8
2. A1A4A2
+5VDC = U1,U2 PIN 16
+5VDC = U3,U4 PIN 14
GND = U1,U2 PIN 8
GND = U3,U4 PIN 7
3. A1A4A3
+5VDC = U1 PIN 14
+5VDC = U2,U3,U4 PIN 16
+5VDC = U5,U6 PIN 14
+5VDC = U9 PIN 16
GND = U1 PIN 7
GND = U2,U3,U4 PIN 8
GND = U5 U6 PIN 7
GND = U9 PIN 3
C. * = SELECTED VALUE: INITIAL VALUES MAY BE SHOWN
D. [ ] INDICATES COMPONENTS MOUNTED ON NEXT HIGHER ASSY
E [ ] INDICATES MARKING ON PANEL AND HOUSING
F. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION

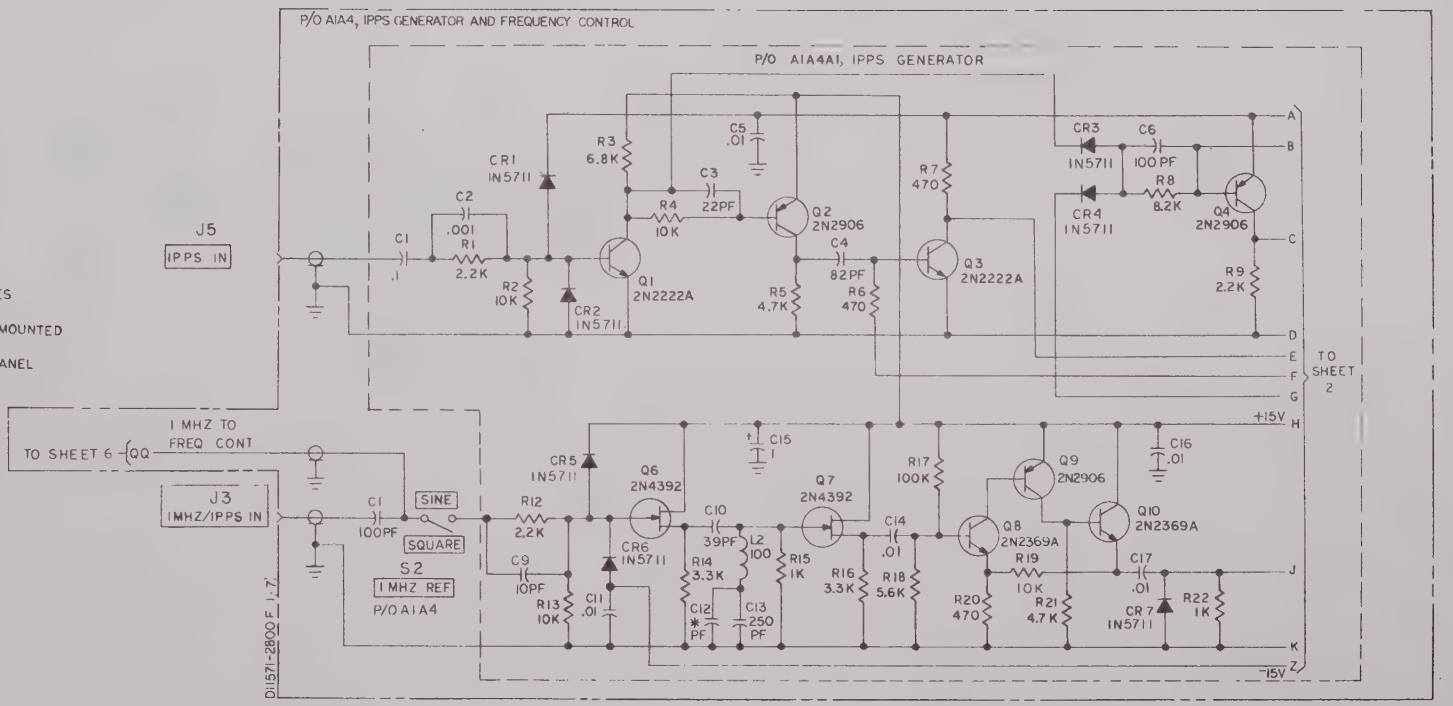


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 1 of 7)

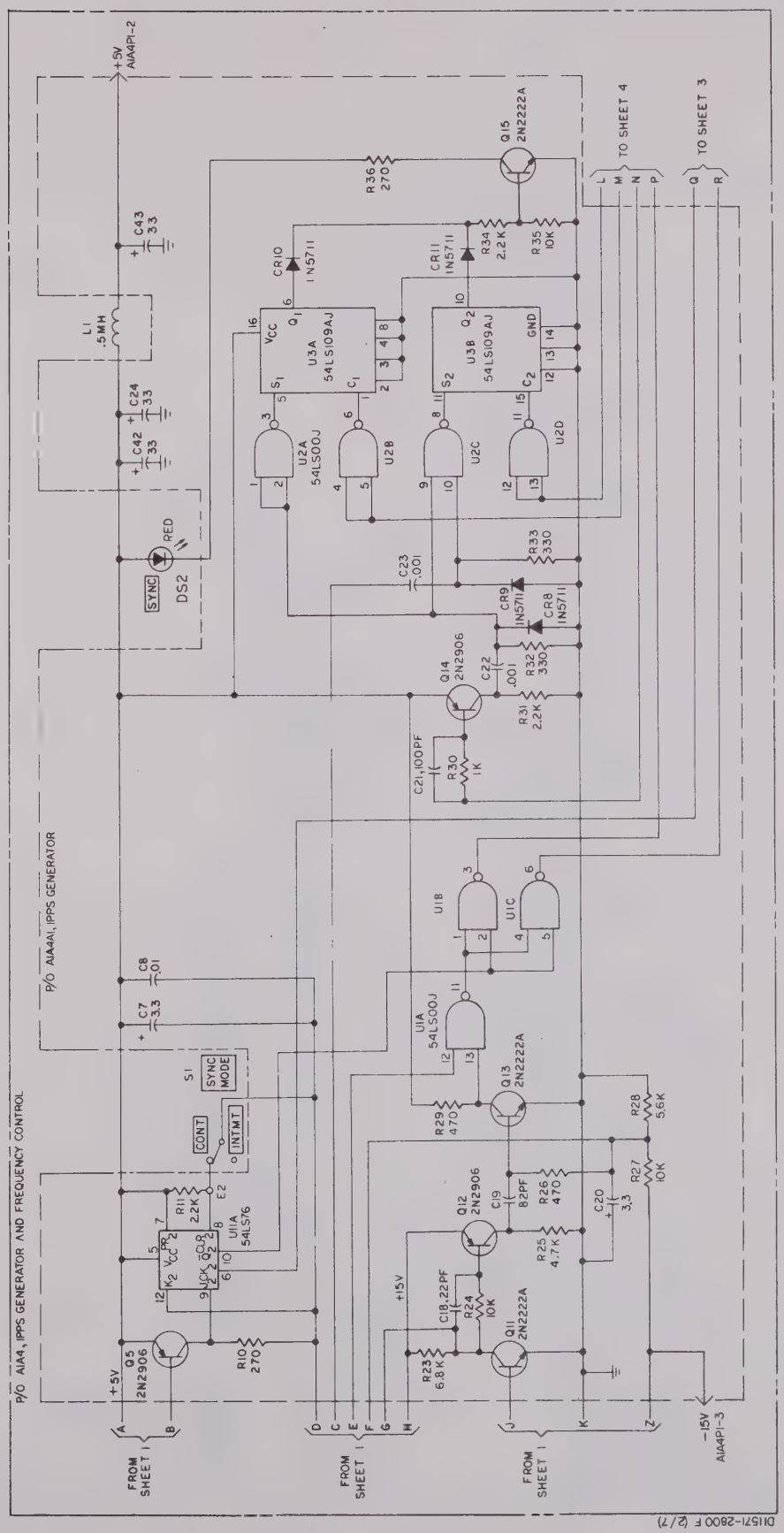


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 2 of 7)

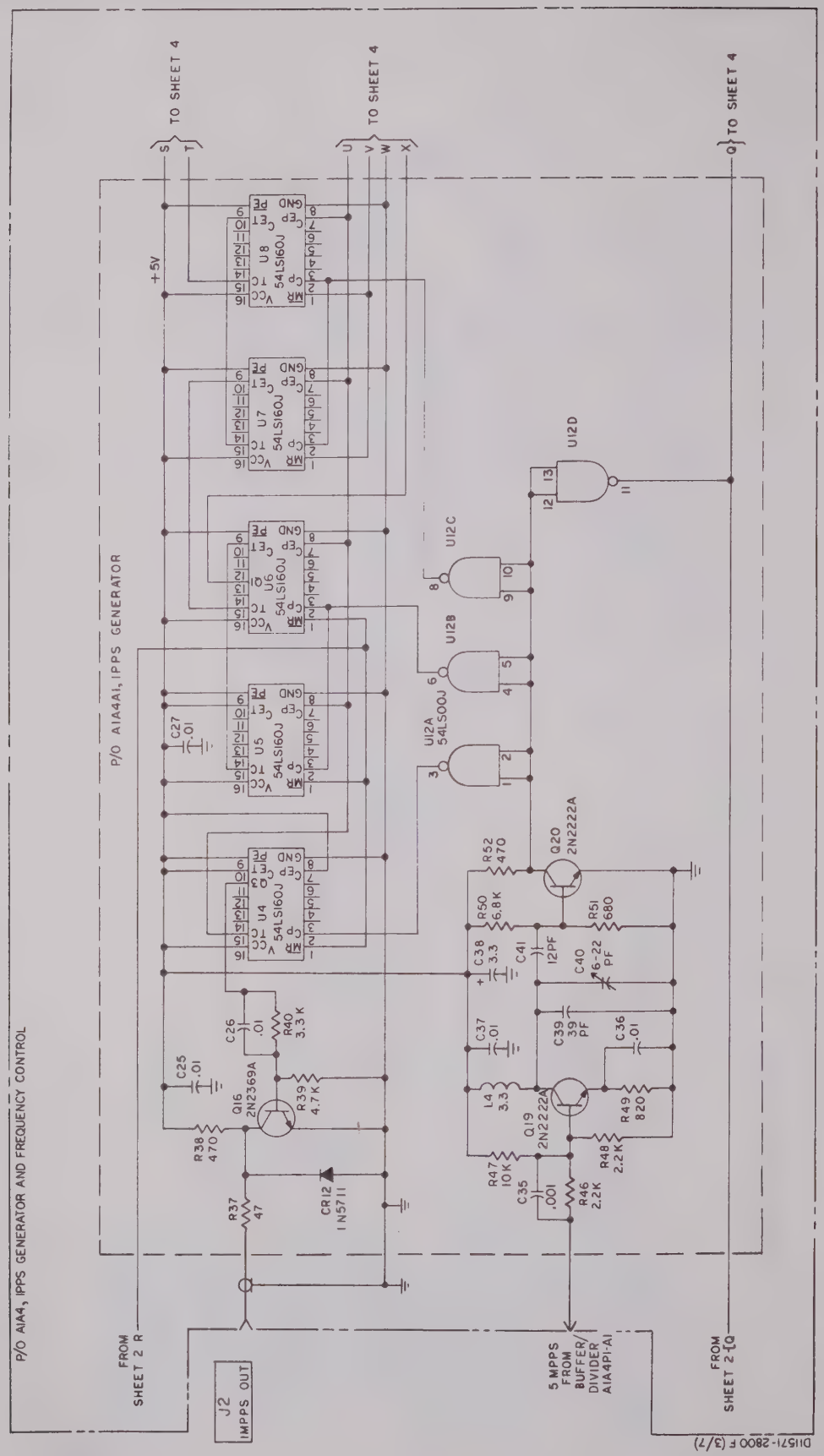


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 3 of 7)

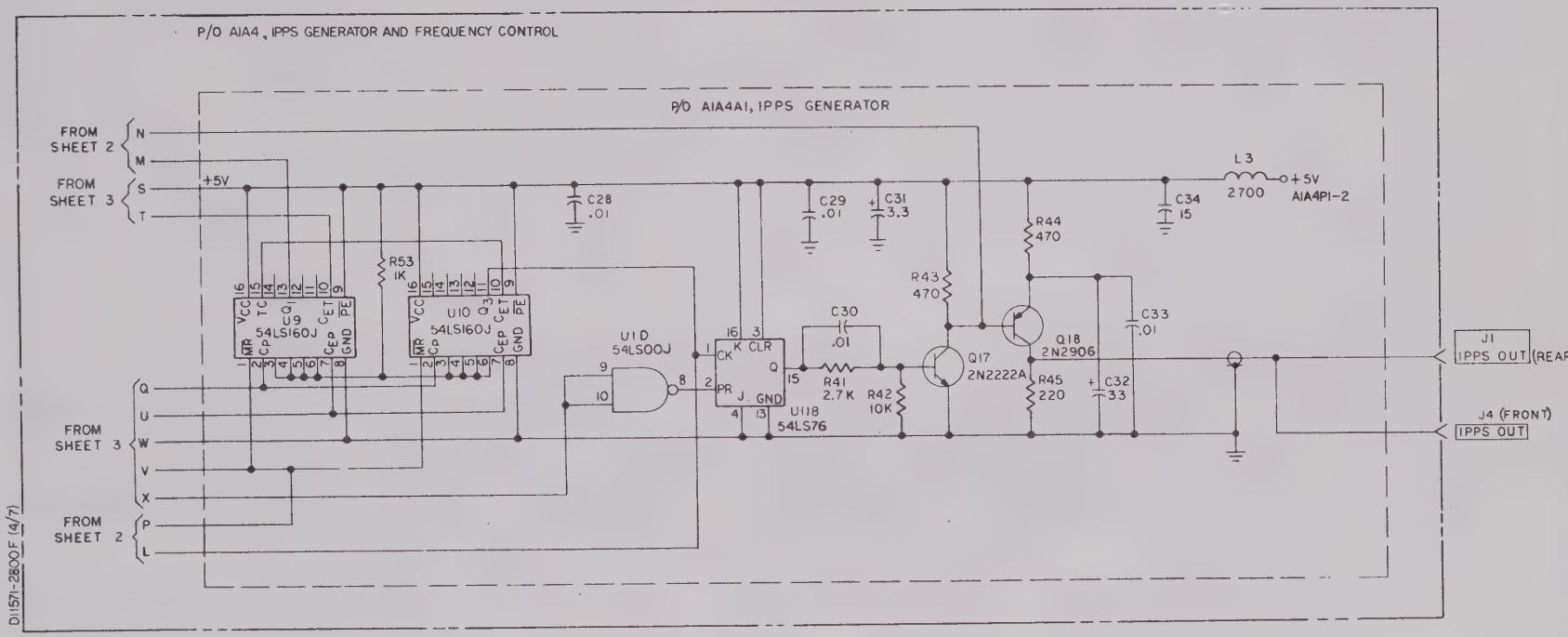


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 4 of 7)

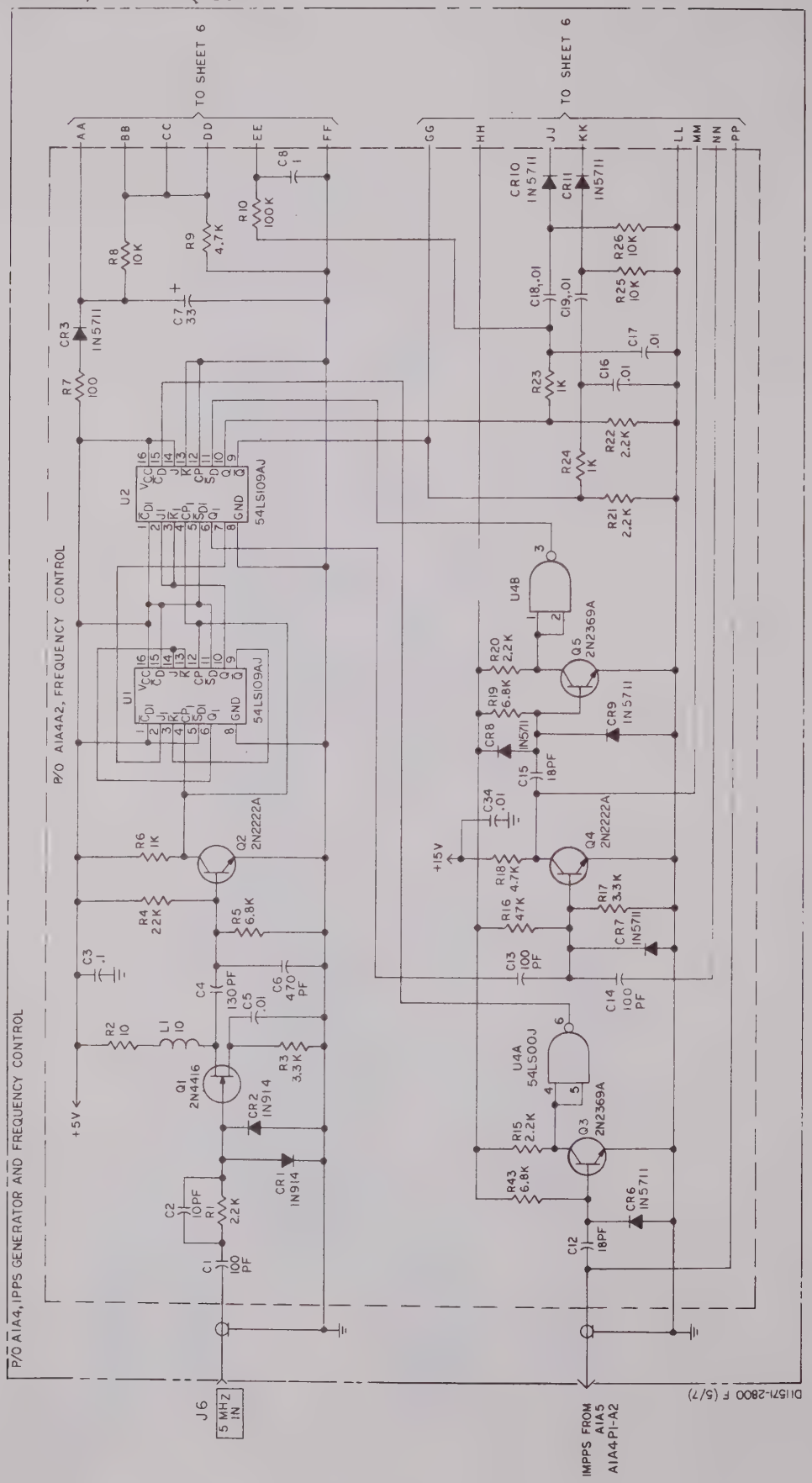


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 5 of 7)

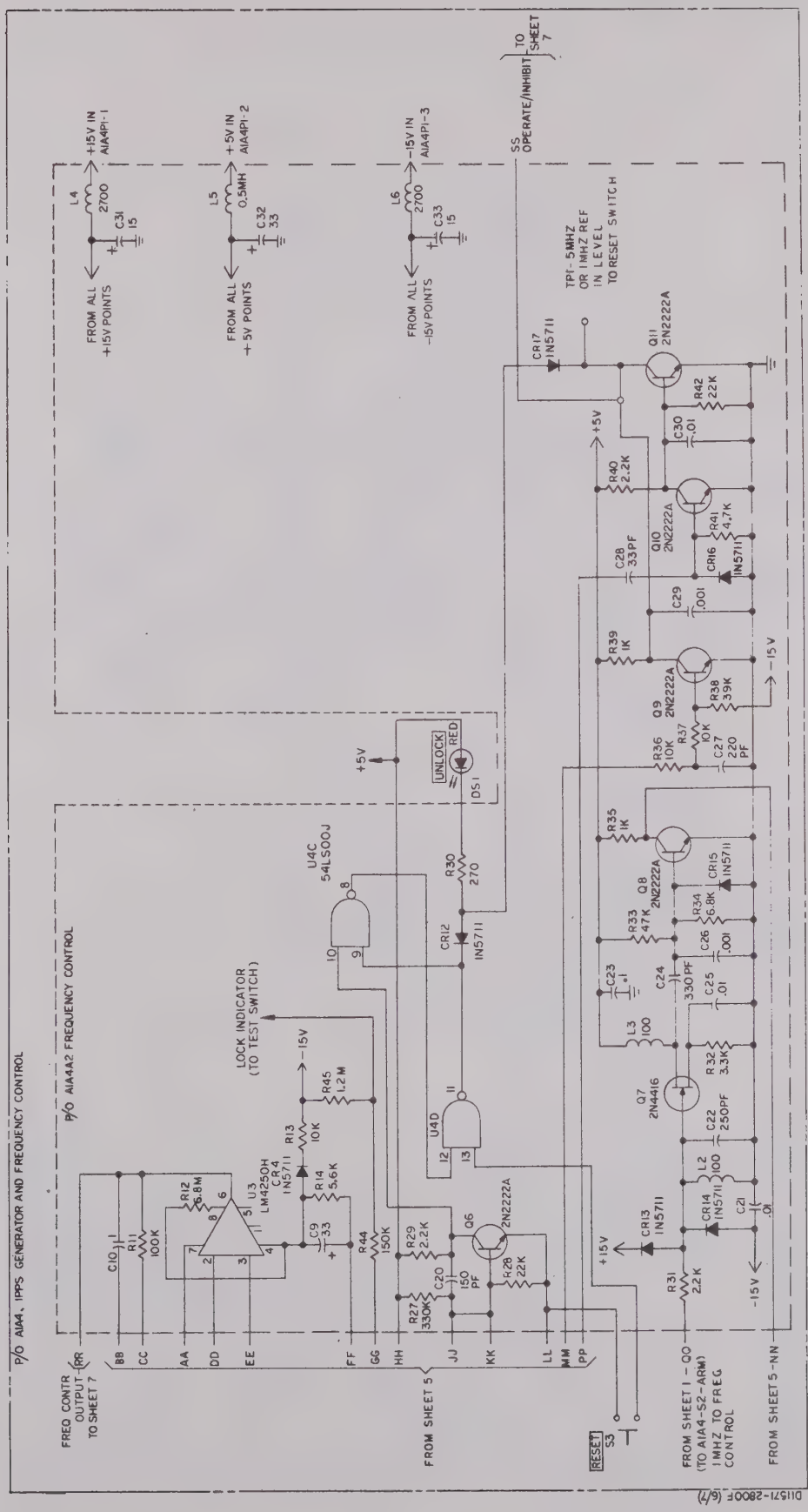


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 6 of 7)

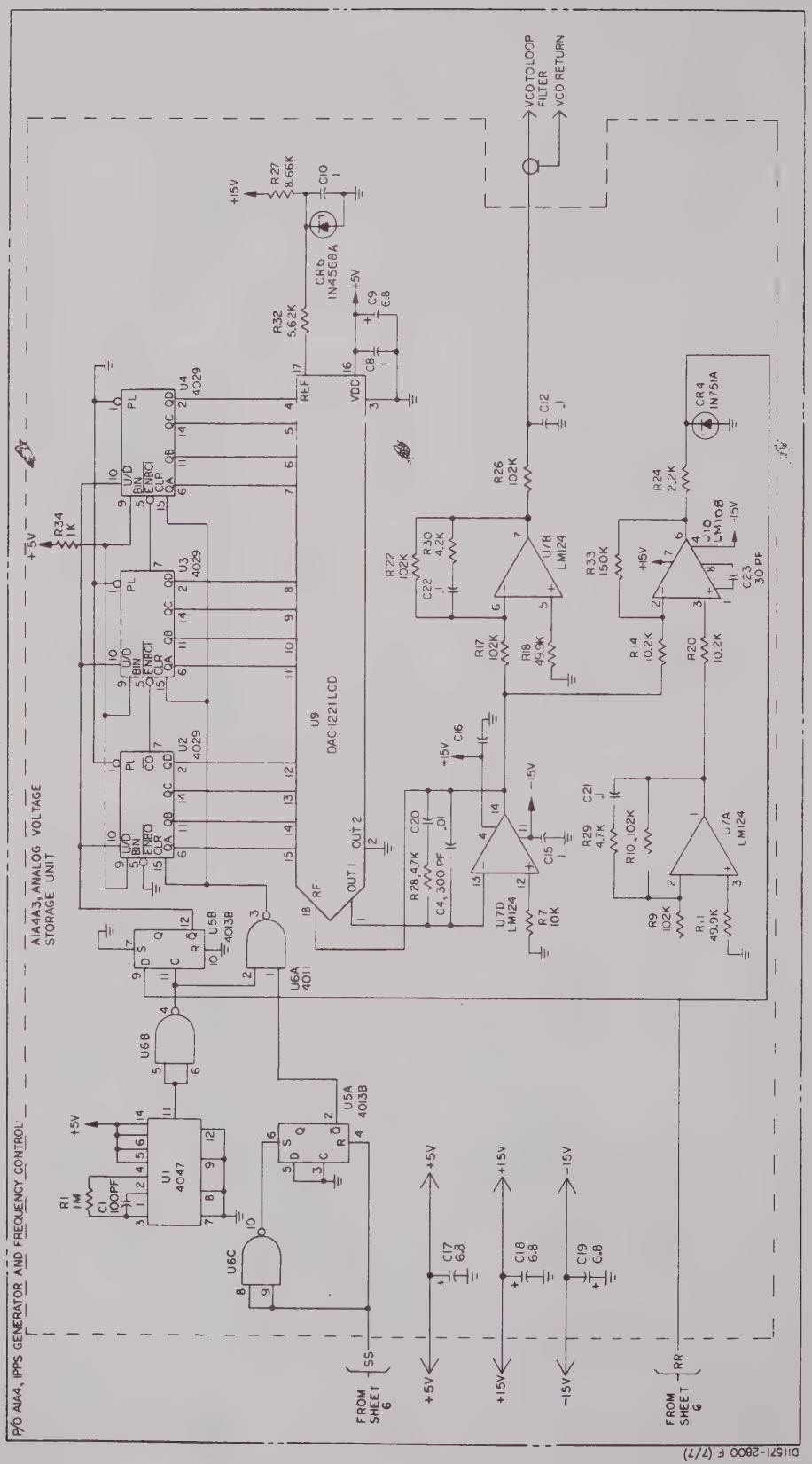


Figure 5-5. 1PPS Generator and Frequency Control A1A4, Schematic Diagram (Sheet 7 of 7)

NOTES:

A. UNLESS OTHERWISE SPECIFIED
   1. ALL RESISTOR VALUES ARE IN OHMS.
   2. ALL CAPACITORS ARE IN UF.
   3. ALL INDUCTORS ARE IN UH.
   4. ALL FETS (2N4416A) ARE CASE GND.
   5. ALL DIODES ARE HP5082-2800.

B. POWER CONNECTIONS:
   1. +5V = U3 PIN 14
      GND = U3 PIN 7

C. *=SELECTED VALUE; INITIAL VALUES MAY BE SHOWN.

D. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION

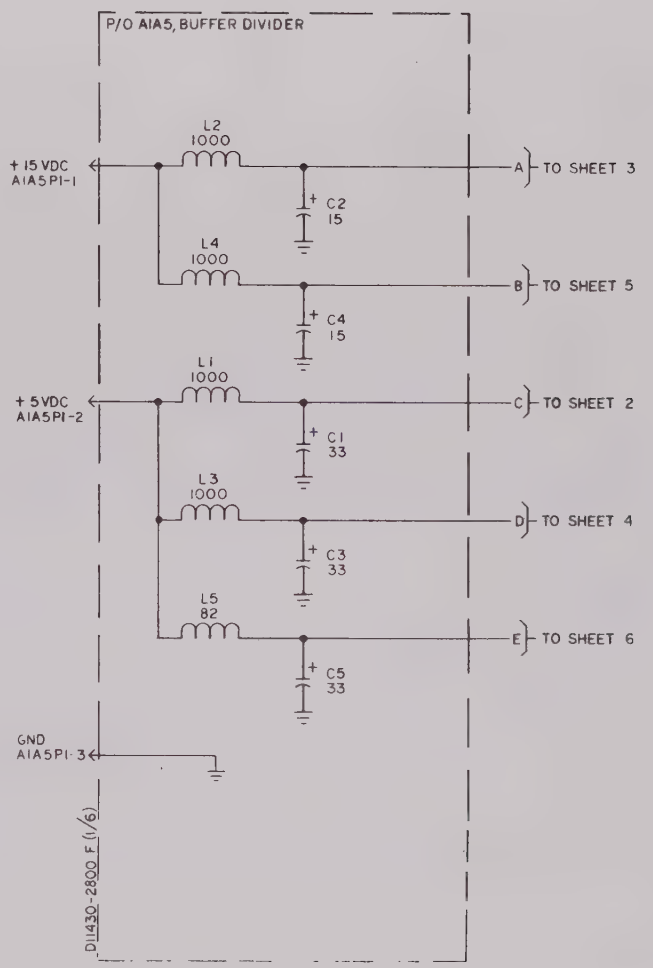


Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 1 of 6)

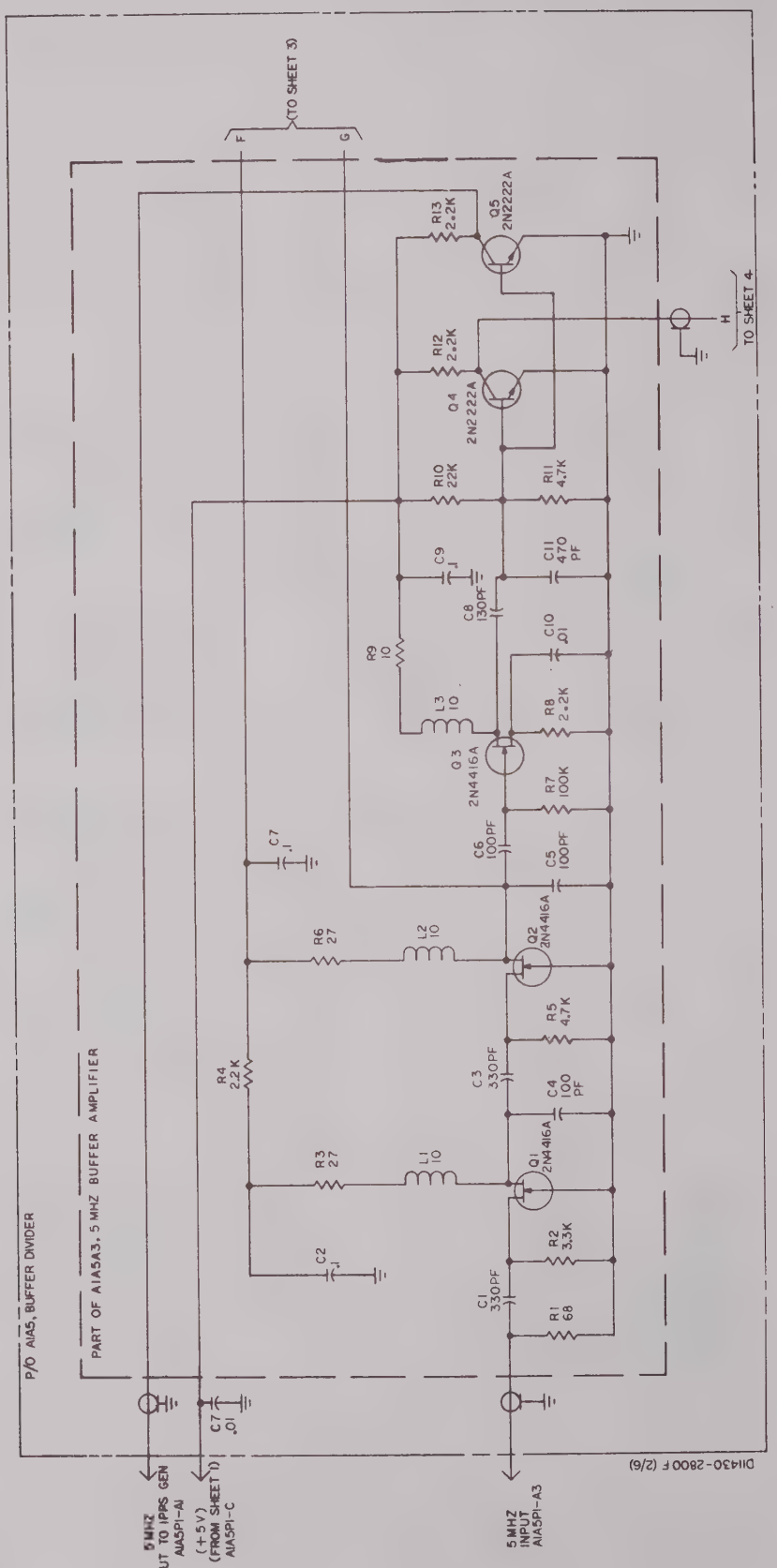


Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 2 of 6)

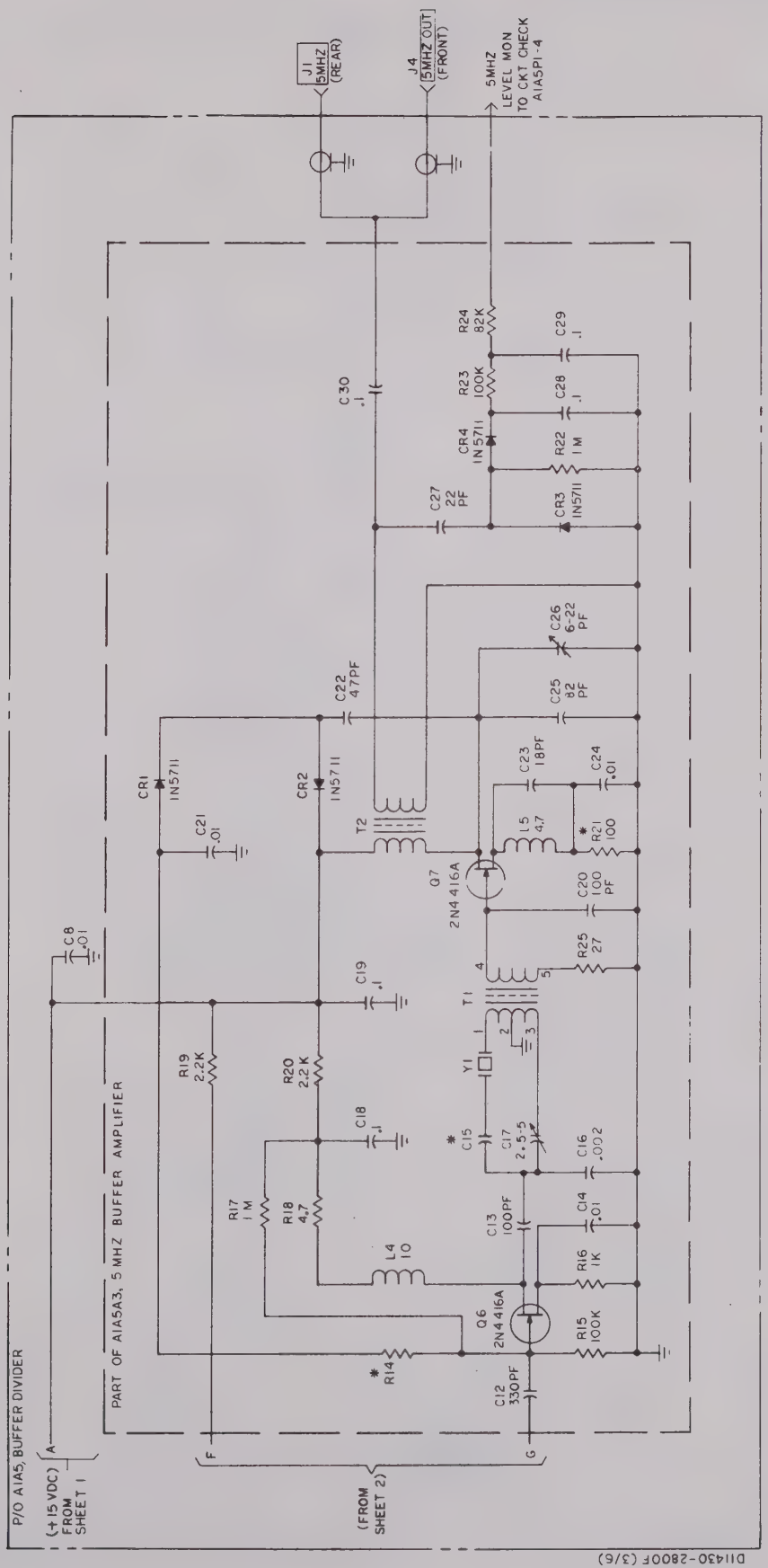

J1 5MHZ (REAR)
J4 5MHZ OUT (FRONT)
5MHZ LEVEL MON TO CKT CHECK A1A5P1-4
P/O A1A5, BUFFER DIVIDER
(+15 VDC) FROM SHEET 1
PART OF A1A5A3, 5 MHZ BUFFER AMPLIFIER
(FROM SHEET 2)
D1143O-2800F (3/6)

Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 3 of 6)

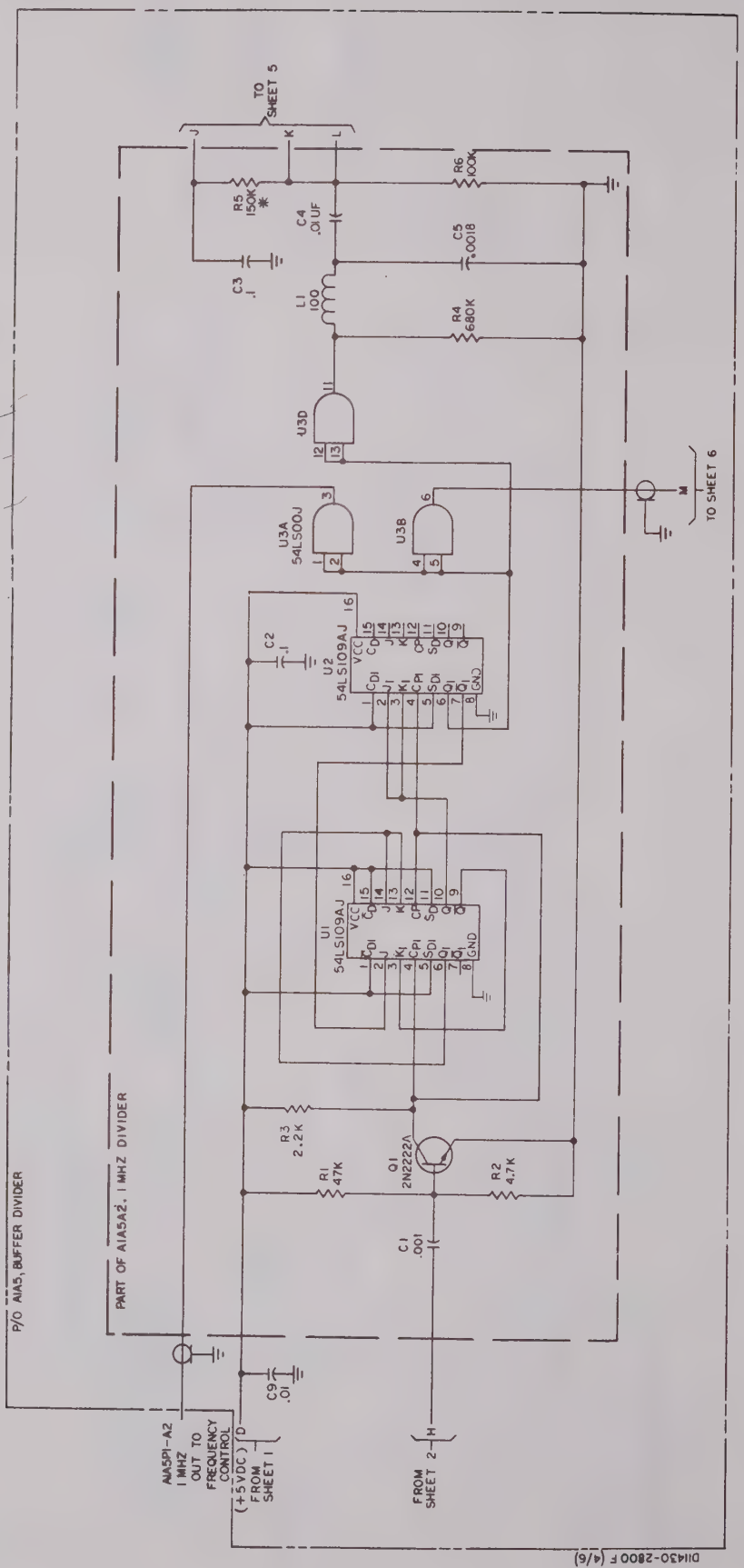


Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 4 of 6)

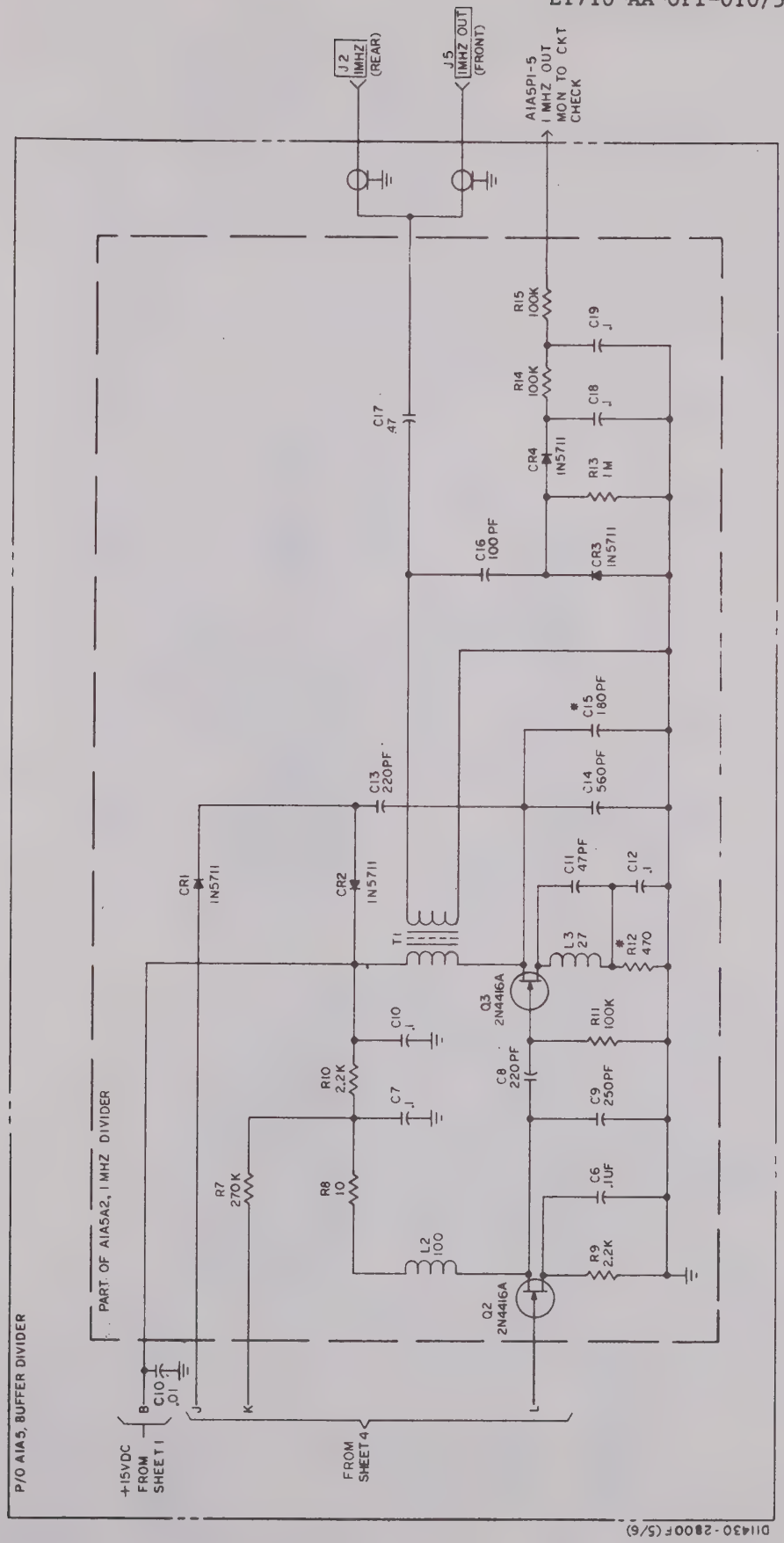


Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 5 of 6)

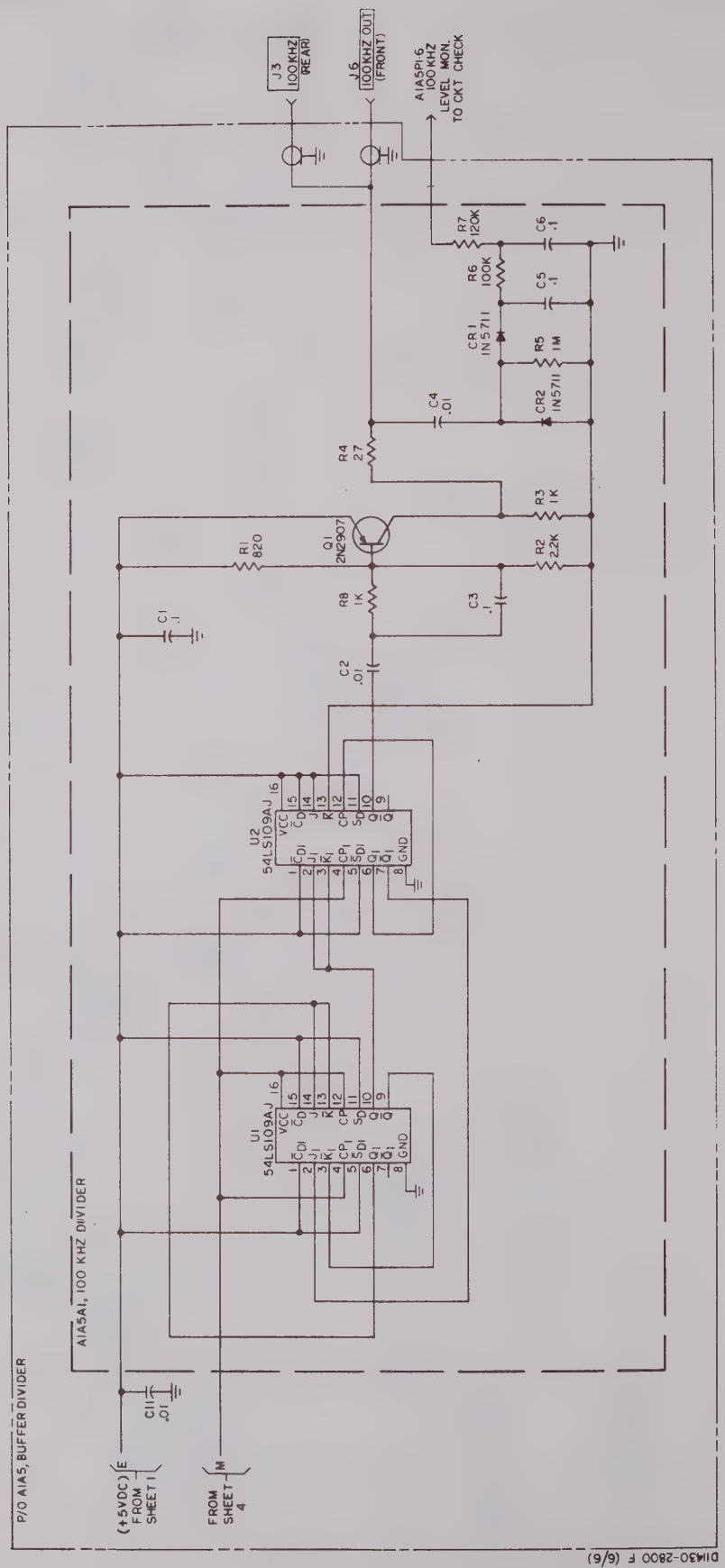


Figure 5-6. Buffer/Divider A1A5, Schematic Diagram (Sheet 6 of 6)

NOTES:

A. UNLESS OTHERWISE SPECIFIED
   1. CAPACITORS ARE IN UF
   2. RESISTORS ARE IN OHMS

B. ☐ INDICATES MARKING ON PANEL

C. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION

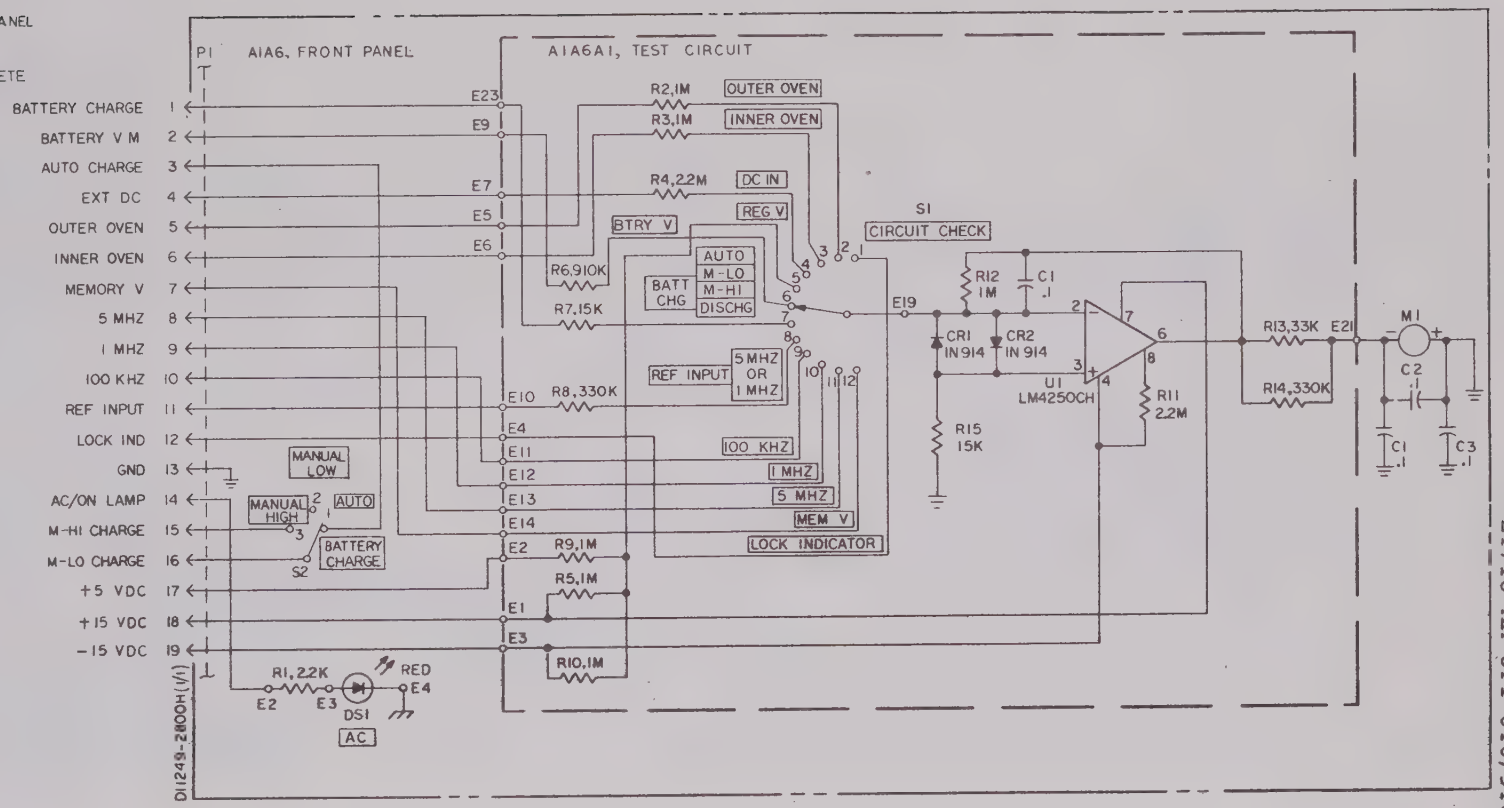
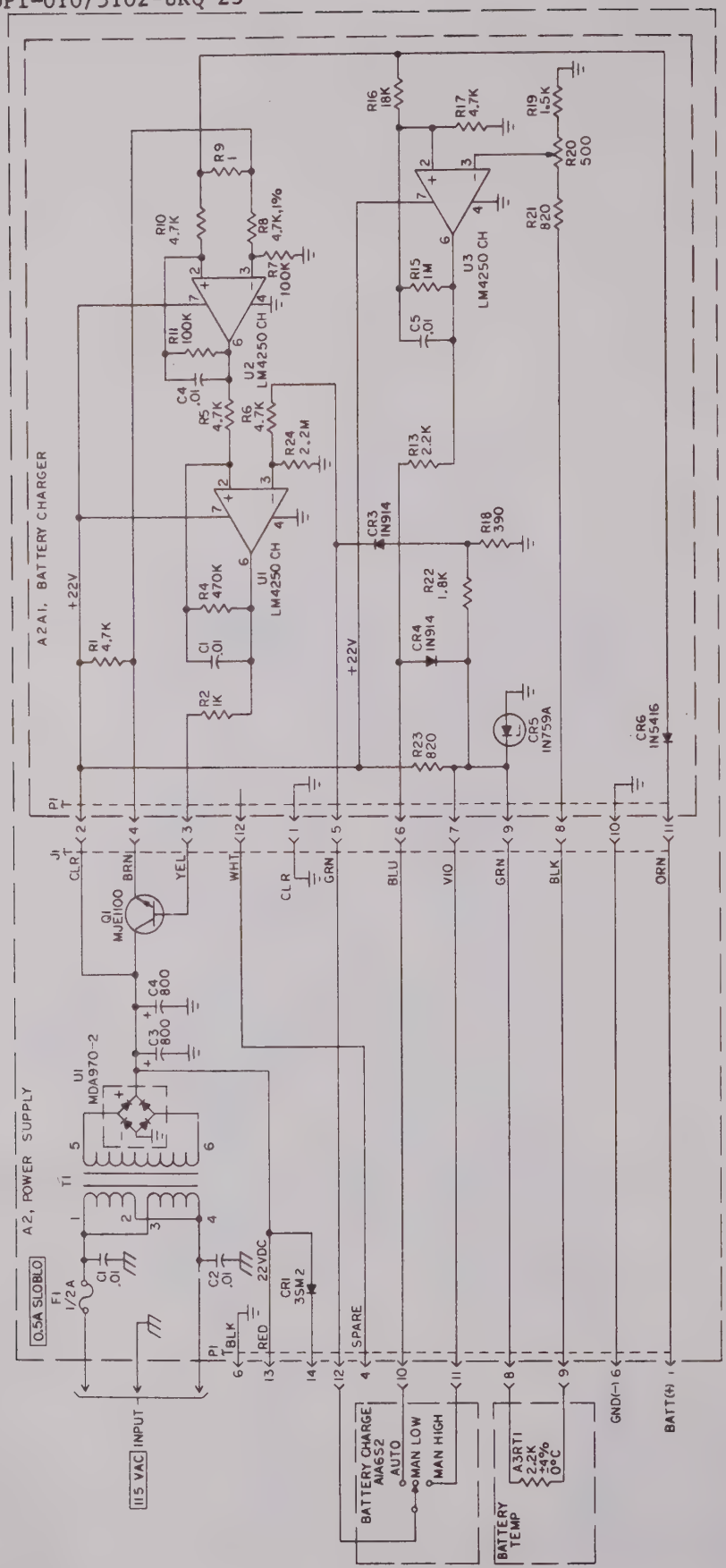


Figure 5-7. Front Panel A1A6, Schematic Diagram

ET710-AA-OPI-010/5102-URQ-23



NOTES:
A. UNLESS OTHERWISE INDICATED
1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL CAPACITOR VALUES ARE IN UF.
B. WHEN PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, COMPLETE THE DESIGNATION WITH MODULE AND/OR ASSEMBLY PREFIX DESIGNATION.

Figure 5-8. Power Supply A2, Schematic Diagram

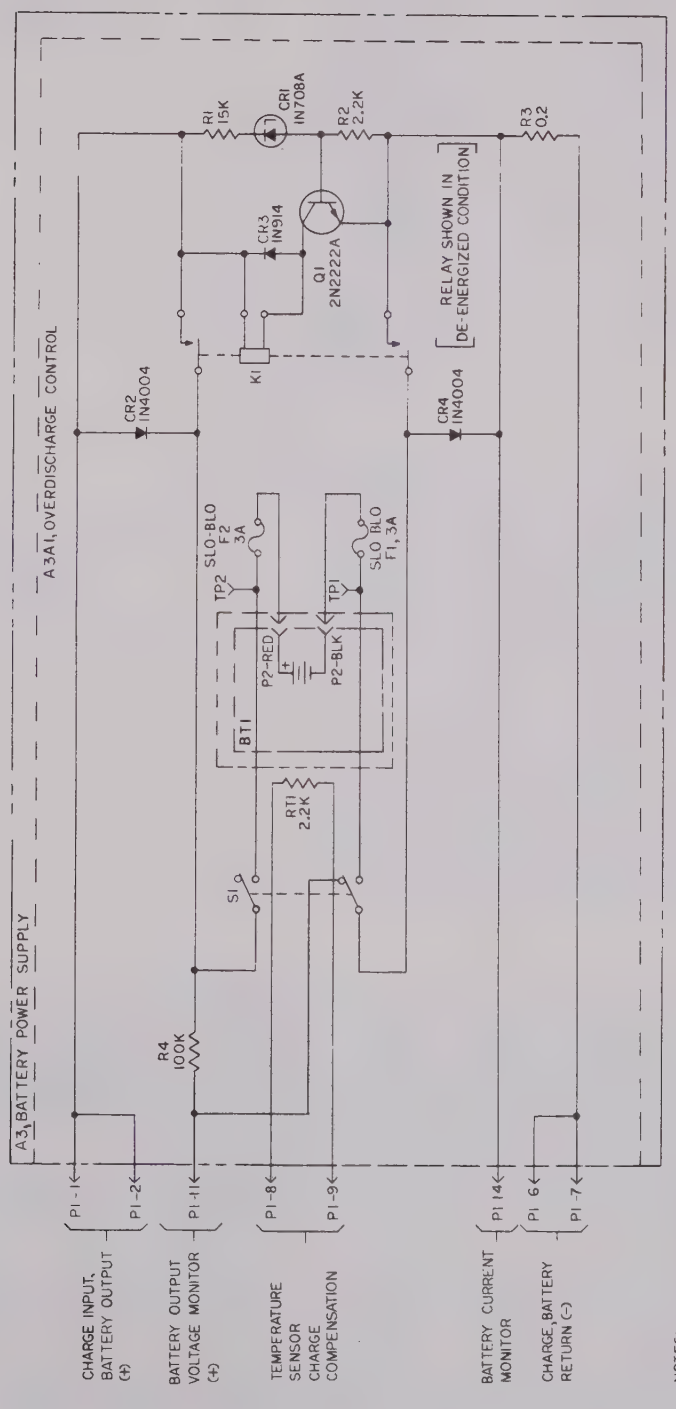


Figure 5-9. Battery Power Supply A3, Schematic Diagram

WIRE LIST

LINE NO.	FROM	TO	AWG	COLOR	FUNCTION	REMARKS
1	J1-1	J2-14	22	RED	+ 22VDC	
2	J1-2	J3-7	22	BLK	GND(-) BAT RTN	
3	J3-7	J3-6	22	BUSS	GND	JUMPER
4	J3-6	J2-6	22	BLK	GND	
5	J1-3	J3-2	22	ORN	+ 12V DC BAT OUTPUT	
6	J1-4	J3-14	26	BRN	(-) BAT, CHG, MON.	
7	J1-5	J2-13	26	YEL	AC PWR ON LAMP	
8	J1-6	J3-11	26	ORN	+ BAT VOLT MON	
9	J1-7	J2-10	26	VIO	AUTO CHG OUTPUT	
10	J1-8	J2-11	26	BLU	MANUAL HIGH CHG OUTPUT	
12	J1-9	J2-12	26	GRN	MANUAL LOW CHARGE OUTPUT	
13	J2-1	J3-1	22	RED	+ 14.2 VDC BAT CHG OUTPUT	
14	J2-8	J3-8	26	GRA	BAT. TEMP SENSOR INPUT	
15	J2-9	J3-9	22	BLK	BAT TEMP SENSOR RETURN	

D11512-2800D

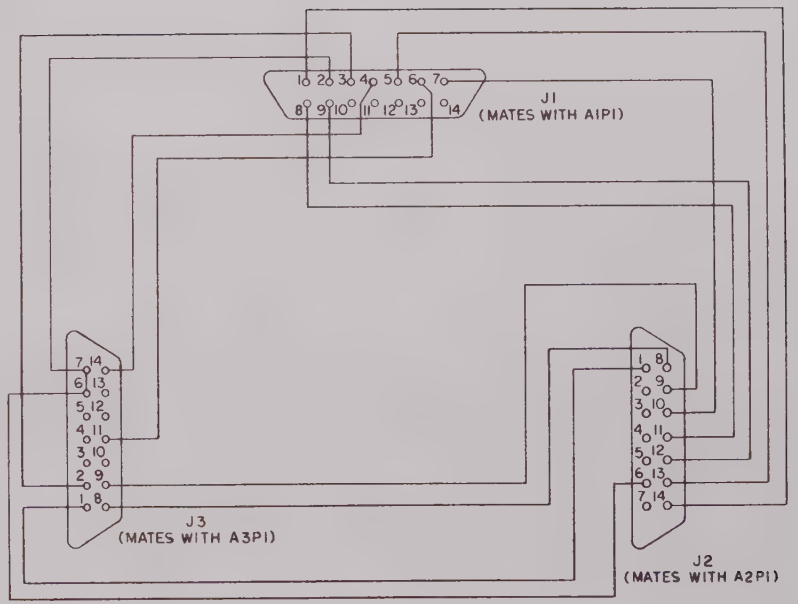
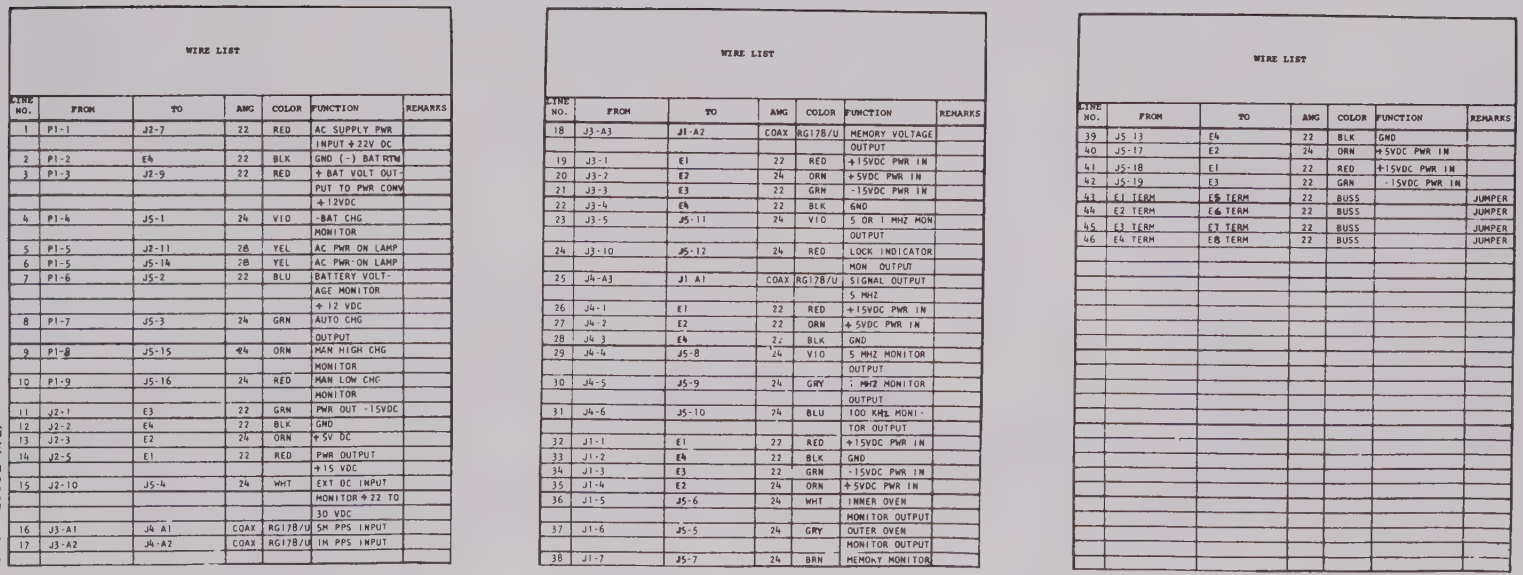


Figure 5-10. Standard Wiring Diagram



WIRE LIST

LINE NO.	FROM	TO	AWG	COLOR	FUNCTION	REMARKS
1	P1-1	J2-7	22	RED	AC SUPPLY PWR INPUT +22V DC	
2	P1-2	E4	22	BLK	GND (-) BAT RTN	
3	P1-3	J2-9	22	RED	+ BAT VOLT OUT-PUT TO PWR CONV +12VDC	
4	P1-4	J5-1	24	VIO	-BAT CHG MONITOR	
5	P1-5	J2-11	28	YEL	AC PWR ON LAMP	
6	P1-5	J5-14	28	YEL	AC PWR ON LAMP	
7	P1-6	J5-2	22	BLU	BATTERY VOLT-AGE MONITOR +12 VDC	
8	P1-7	J5-3	24	GRN	AUTO CHG OUTPUT	
9	P1-8	J5-15	24	ORN	MAN HIGH CHG MONITOR	
10	P1-9	J5-16	24	RED	MAN LOW CHG MONITOR	
11	J2-1	E3	22	GRN	PWR OUT -15VDC	
12	J2-2	E4	22	BLK	GND	
13	J2-3	E2	24	ORN	+5V DC	
14	J2-5	E1	22	RED	PWR OUTPUT +15 VDC	
15	J2-10	J5-4	24	WHT	EXT DC INPUT MONITOR +22 TO 30 VDC	
16	J3-A1	J4 A1	COAX	RG178/U	5M PPS INPUT	
17	J3-A2	J4-A2	COAX	RG178/U	1M PPS INPUT	

WIRE LIST

LINE NO.	FROM	TO	AWG	COLOR	FUNCTION	REMARKS
18	J3-A3	J1-A2	COAX	RG178/U	MEMORY VOLTAGE OUTPUT	
19	J3-1	E1	22	RED	+15VDC PWR IN	
20	J3-2	E2	24	ORN	+5VDC PWR IN	
21	J3-3	E3	22	GRN	-15VDC PWR IN	
22	J3-4	E4	22	BLK	GND	
23	J3-5	J5-11	24	VIO	5 OR 1 MHZ MON OUTPUT	
24	J3-10	J5-12	24	RED	LOCK INDICATOR MON OUTPUT	
25	J4-A3	J1 A1	COAX	RG178/U	SIGNAL OUTPUT 5 MHZ	
26	J4-1	E1	22	RED	+15VDC PWR IN	
27	J4-2	E2	22	ORN	+5VDC PWR IN	
28	J4-3	E4	22	BLK	GND	
29	J4-4	J5-8	24	VIO	5 MHZ MONITOR OUTPUT	
30	J4-5	J5-9	24	GRY	1 MHZ MONITOR OUTPUT	
31	J4-6	J5-10	24	BLU	100 KHZ MONI-TOR OUTPUT	
32	J1-1	E1	22	RED	+15VDC PWR IN	
33	J1-2	E4	22	BLK	GND	
34	J1-3	E3	22	GRN	-15VDC PWR IN	
35	J1-4	E2	24	ORN	+5VDC PWR IN	
36	J1-5	J5-6	24	WHT	INNER OVEN MONITOR OUTPUT	
37	J1-6	J5-5	24	GRY	OUTER OVEN MONITOR OUTPUT	
38	J1-7	J5-7	24	BRN	MEMORY MONITOR	

WIRE LIST

LINE NO.	FROM	TO	AWG	COLOR	FUNCTION	REMARKS
39	J5 13	E4	22	BLK	GND	
40	J5-17	E2	24	ORN	+5VDC PWR IN	
41	J5-18	E1	22	RED	+15VDC PWR IN	
42	J5-19	E3	22	GRN	-15VDC PWR IN	
43	E1 TERM	E5 TERM	22	BUSS		JUMPER
44	E2 TERM	E6 TERM	22	BUSS		JUMPER
45	E3 TERM	E7 TERM	22	BUSS		JUMPER
46	E4 TERM	E8 TERM	22	BUSS		JUMPER

D11514-2800E (1/2)

Figure 5-11. Rf Oscillator A1, Wiring Diagram (Sheet 1 of 2)

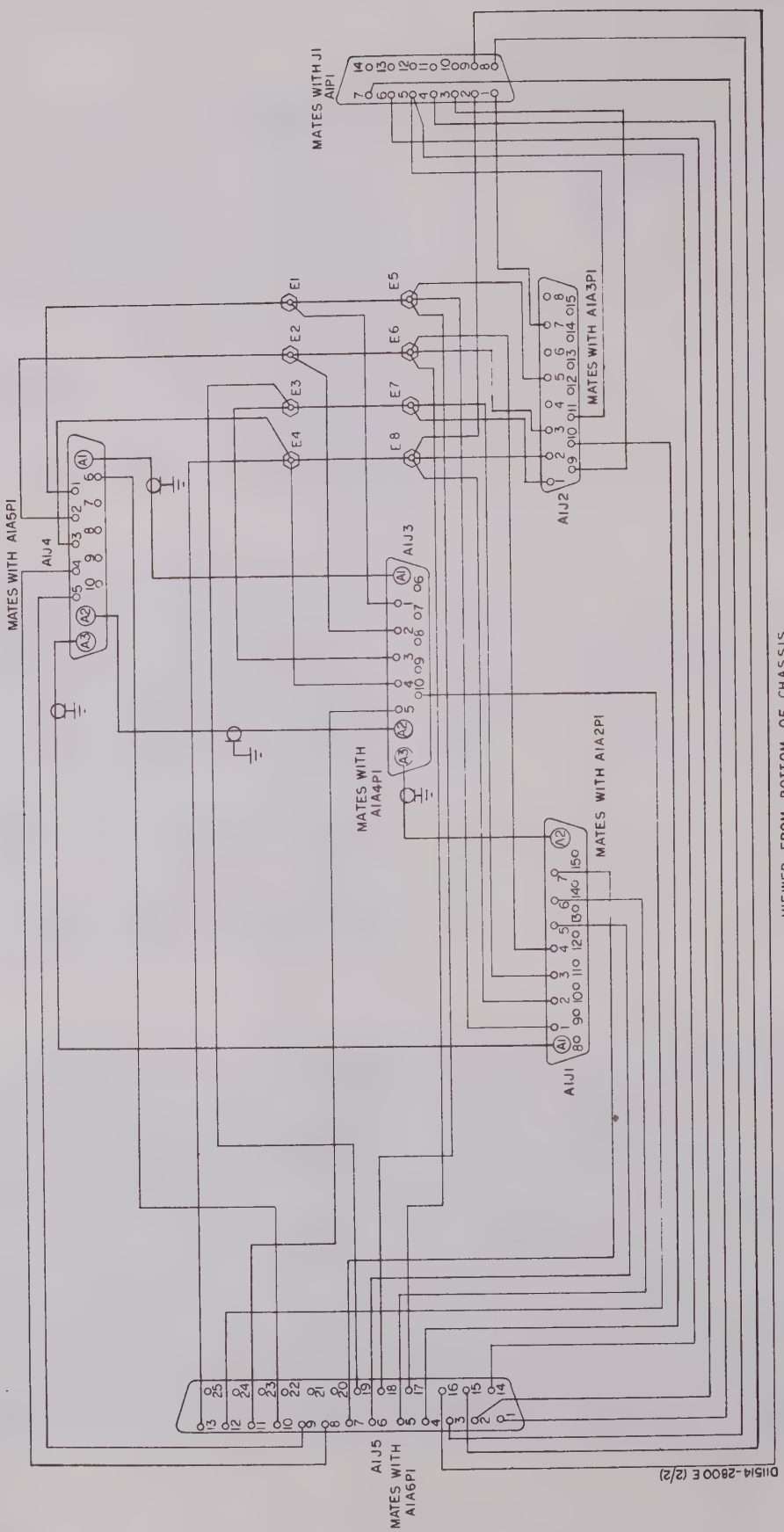
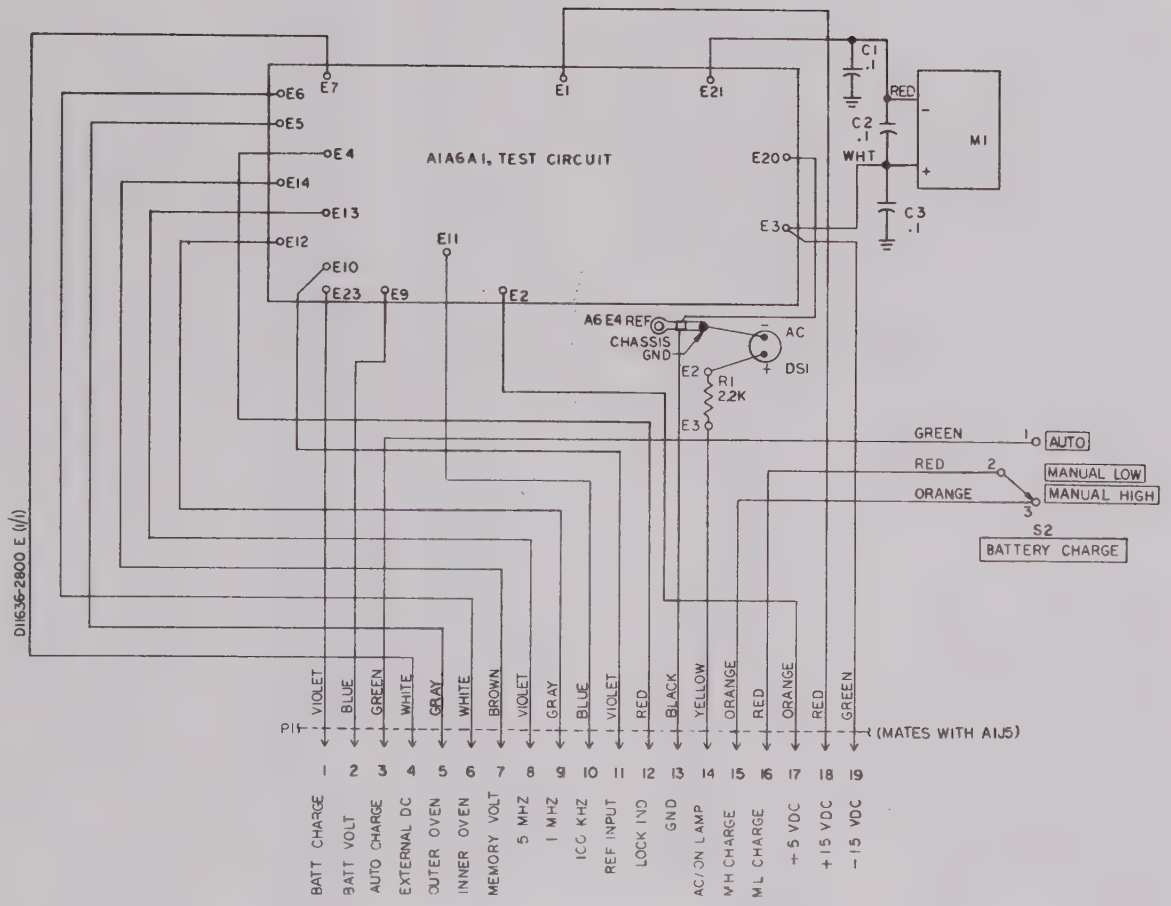


Figure 5-11. Rf Oscillator A1, Wiring Diagram (Sheet 2 of 2)



WIRE LIST

WIRE NO.	FROM	TO	AWG	COLOR	FUNCTION	REMARKS
1	P1-1	A1-E23	24	VIO	BATTERY CHGE	
2	P1-2	A1-E9	24	BLU	BATTERY VOLTAGE	
3	P1-3	S2-1	22	GRN	AUTO CHARGE	
4	P1-4	A1-E7	24	WHT	EXT. DC	
5	P1-5	A1-E5	24	GRY	OUTER OVEN	
6	P1-6	A1-E6	24	WHT	INNER OVEN	
7	P1-7	A1-E14	24	BRN	MEMORY VOLTAGE	
8	P1-8	A1-E13	24	VIO	5 MHZ	
9	P1-9	A1-E12	24	GRY	1 MHZ	
10	P1-10	A1-E11	24	BLU	100 KHZ	
11	P1-11	A1-E10	24	VIO	REF INPUT	
12	P1-12	A1-E4	24	RED	LOCK IND	
13	P1-13	E4	22	BLK	GND	
14	P1-14	E3	22	YEL	AC/ON LAMP	
15	P1-15	S2-3	22	ORN	MANUAL HIGH CHARGE	
16	P1-16	S2-2	22	RED	MANUAL LOW CHARGE	
17	P1-17	A1-E2	22	ORN	+5V DC	
18	P1-18	A1-E1	22	RED	+15V DC	
19	P1-19	A1-E3	22	GRN	-15V DC	
20	A1-E3	M1 (+)	22	WHT	-15V DC METER	
21	A1-E21	M1 (-)	22	RED	METER VOLTAGE	
22	A1-E20	E4	22	BLK	GND	
23	DS1 (-)	E4	22	BUSS		JUMPER
24	DS1 (+)	E2	22	BUSS		JUMPER

Figure 5-12. Front Panel A1A6, Wiring Diagram

CHAPTER 6

CORRECTIVE MAINTENANCE

6-1. INTRODUCTION. This chapter contains information describing alignment and adjustment procedures and the steps necessary to remove and reinstall all repairable modules and assemblies that can be accomplished by organizational maintenance level personnel. The chapter is divided into two sections. Section I contains instructions for the performance of alignment and adjustment procedures. Section II contains instructions for repair of the standard.

Section I. ADJUSTMENTS AND ALIGNMENTS

6-2. GENERAL. If a calibrated reference signal source is available with an accuracy of $\pm 5 \times 10^{-11}$ or better, a voltage level of approximately 1.0 volt rms and an output frequency of 5 MHz or 1 MHz, all corrective maintenance must be performed as specified. If a calibrated reference signal source is not available, those procedures which require its use must be deferred until the standard is removed for calibration or until an appropriate signal source is obtained. The following equipment or their equivalents qualify as acceptable reference signal sources: O-1695A/U, HP-5061A or HP-5062C Cesium Beam Frequency Standards; another calibrated AN/URQ-23 Frequency-Time Standard; or an Omega, Loran-C, or Verdin RF Transmission. Adjustments and alignments required for the corrective maintenance of the standard are detailed in paragraph 6-3.

6-3. PROCEDURES. The only adjustment and alignment procedures required for the standard are those that establish the basic frequency of the standard outputs. Those procedures involve the adjustment of the COARSE and FINE ADJUST controls on the front of the standard. Although located on 5MHz oscillator A1A1, both controls are accessible through holes in front panel A1A6 when protective caps are removed. The procedure for the adjustment of the COARSE and FINE ADJUST controls is described in subparagraph 2-4b.

Section II. REPAIR

6-4. GENERAL. Repair procedures for the standard at the organizational maintenance level are confined to the replacement of modules and assemblies that have been identified as defective during troubleshooting. The following paragraphs contain instructions for the disassembly and reassembly of the modules and for the removal and reinstallation of the assemblies.

6-5. DISASSEMBLY OF STANDARD. Perform the procedures contained in each of the following subparagraphs to disassemble the standard to remove each applicable module. Table 6-1 lists the tools, materials and equipment required for corrective maintenance.

Table 6-1. Equipment Required for Corrective Maintenance

Equipment*	Description
Cloth, Lint-free	NSN-7920-205-3453
Fiber Brush	Soft, Non-metallic
Vacuum Cleaner	Any model with non-metallic nozzle
Flat-head Screwdriver	8-inch Excelite No. R3164
Phillips Screwdriver	Excelite No. X101
Multimeter	(See table 1-7)
*Equivalents may be used.	

a. Rf Oscillator A1. To remove rf oscillator A1 from the standard, proceed as follows:

(1) Disconnect and remove all input and output cables that mate with connectors on rf oscillator A1.

(2) Loosen the four knurled-head captive screws that secure front panel A1A6 to the enclosure.

(3) Remove front panel A1A6 from rf oscillator A1 and the standard.

(4) Loosen the two knurled-head captive fasteners that secure rf oscillator A1.

(5) Slide rf oscillator A1 out of the standard.

b. Power Supply A2. To remove power supply A2 from the standard, proceed as follows:

(1) Using a flat-head screwdriver, loosen the three knurled-head screws that secure the front of power supply A2 to the rear of the standard.

(2) Slide power supply A2 out of the standard.

c. Battery Power Supply A3. To remove battery power supply A3 from the standard, proceed as follows:

(1) Using a flat-head screwdriver, loosen the four knurled-head screws that secure battery power supply A3 to the front of the standard.

(2) Slide battery power supply A3 out of the standard.

(3) Place the ON/OFF switch on the rear of battery power supply A3 to OFF.

6-6. DISASSEMBLY OF RF OSCILLATOR A1. Perform the following procedure to remove the assemblies of rf oscillator A1:

a. Remove the two connector hold-down screws that secure plug A2P1 to jack A1J1.

b. Disconnect plug A2P1 from jack A1J1.

c. Remove the tab hold-down screws on 5MHZ oscillator A1A1.

d. Remove the three hold-down screws from underneath the carrier chassis to release loop filter/oscillator tuning assembly A1A2. Remove the assembly.

e. Remove the two hold-down nuts at the rear of loop filter/oscillator tuning assembly A1A2 that secure 5MHZ oscillator A1A1.

f. Separate loop filter/oscillator tuning assembly A1A2 from 5 MHZ oscillator A1A1.

g. Loosen the two captive screws that protrude through the top of power converter A1A3.

h. Pull power converter A1A3 out of rf oscillator A1.

i. Loosen the two captive screws that protrude through the top of 1 PPS generator and frequency control A1A4.

j. Pull 1 PPS generator and frequency control A1A4 out of rf oscillator A1.

k. Loosen the two captive screws that protrude through the top of buffer/divider A1A5.

l. Pull buffer/divider A1A5 out of rf oscillator A1.

6-7. DISASSEMBLY OF POWER SUPPLY A2. Perform the following procedures to remove power supply A2.

a. Loosen the three phillips hold-down screws at the top cover of power supply A2.

b. Remove ac converter and battery charger A2A1 from power supply A2.

6-8. DISASSEMBLY OF BATTERY POWER SUPPLY A3 (AND INTERNAL BATTERY PACK).

a. Remove battery power supply A3 from the standard by loosening the four knurled-head captive fasteners at the front of the standard .

b. Slide battery power supply A3 out of the standard.

c. Place ON/OFF switch S1 on battery power supply A3 to the OFF position.

d. Remove and retain the 10 phillips screws that secure the top cover of the battery power supply.

e. Remove top cover.

f. If the battery pack is to be replaced, loosen (do not remove) the four phillips screws (two in each side) securing the two brackets which hold the battery pack in place.

g. Disconnect the battery pack connector by pulling it upward and away from the printed circuit board.

h. Remove the battery pack by sliding it out of the module.

i. Check and replace the fuse if required.

6-9. REASSEMBLY OF BATTERY POWER SUPPLY A3.

a. Install battery pack inside the module with marking label facing up.

b. Plug the keyed connector into the printed circuit board. (Red wire is positive terminal and black wire is negative terminal.)

c. Secure the two brackets against the battery pack and tighten the four phillips screws. Ensure that the battery pack is not loose.

d. Install the top cover in position and secure it with 10 phillips screws.

e. Place the ON/OFF switch on battery power supply A3 to the ON position.

f. Return battery power supply A3 to its position in the standard and tighten the four knurled-head captive fasteners used to secure the module.

6-10. REASSEMBLY OF POWER SUPPLY A2. Perform the following procedure to reassemble power supply A2:

a. Install ac converter and battery power charger A2A1 in power supply A2.

b. Tighten the three phillips hold-down screws at the top cover of power supply A2.

6-11. REASSEMBLY OF RF OSCILLATOR A1. Perform the following procedure to reassemble rf oscillator A1:

a. Install buffer/divider A1A5 in rf oscillator A1. (See figure 7-1 for assembly locations.)

b. Secure buffer/divider A1A5 in place with the two bolts that protrude through the top of the assembly.

c. Install 1 PPS generator and frequency control A1A4 in rf oscillator A1. (See figure 7-1 for assembly locations.)

d. Secure 1 PPS generator and frequency control A1A4 with the two bolts that protrude through the top of the assembly.

e. Install power converter A1A3 in rf oscillator A1.

f. Secure power converter A1A3 in place with the two bolts that protrude through the top of the assembly.

g. Join loop filter/oscillator tuning assembly A1A2 to 5 MHz oscillator assembly A1A1 by joining the mating connectors. Union of the two assemblies is accomplished by inserting the two studs on A1A1 into the female receptacles on A1A2.

h. Secure loop filter/oscillator tuning assembly A1A2 to 5 MHz oscillator A1A1 with two hold-down nuts at the rear of loop filter/oscillator tuning assembly A1A2.

i. Install the assembled loop filter/oscillator tuning assembly A1A2 and the 5 MHz oscillator A1A1 assembly in rf oscillator module A1. (See figure 7-1 for assembly locations.)

j. Secure the assembled loop filter/oscillator tuning assembly A1A2 and 5 MHz oscillator A1A1 to the chassis of rf oscillator A1 with the three hold-down screws.

k. Install the tab hold-down screw on 5 MHz oscillator A1A1.

l. Connect plug A1P1 to jack A1J1.

m. Secure plug A1P1 to jack A1J1 with the two connector hold-down screws.

6-12. REASSEMBLY OF STANDARD. Perform the following procedure to reassemble the standard:

a. Slide battery power supply A3 in place.

b. Secure battery power supply A3 by tightening the four knurled-head captive screws at the front of the standard.

c. Slide power supply A2 in place.

d. Secure power supply A2 by tightening the three knurled-head captive fasteners at the front of the standard.

e. Slide rf oscillator A1 into the enclosure.

f. Tighten the two captive fasteners at the rear of the standard.

g. To install front panel A1A6, tighten the four captive screws at the front of the standard.

h. Reconnect all cables that are to be used in the installation of the standard.

CHAPTER 7

PARTS LIST

7-1. INTRODUCTION. This chapter lists and identifies the location of repair parts and attaching hardware for Frequency-Time Standard AN/URQ-23, manufactured by Frequency Electronics, Inc., New Hyde Park, New York 11040.

a. Major Components. The major components (modules) of the standard are listed in table 7-1.

Table 7-1. List of Major Components

CID Number	Quantity	Name
FE-150A	1	Radio Frequency Oscillator, O-1783/URQ-23
FE-250A	1	Power Supply, PP-7557/URQ-23
FE-350A	1	Battery Power Supply, BB-712/URQ-23

b. Parts List. Repair parts for the components listed in table 7-1 are listed in table 7-2. Table 7-2 contains four columns as follows:

(1) Reference Designations. This column contains the reference designation that has been assigned to the repair part. Reference designations are assigned in accordance with USAS Y32.16.

(2) Notes. This column is not applicable to the repair parts of the standard at the time of publication of this technical manual.

(3) Name and Description. This column contains the name that has been assigned to the repair part by the manufacturer. Where applicable, information that provides additional descriptive data is included. Attaching hardward is listed immediately following the listing of its associated repair part. The hardware is identified by an assigned letter code (A, B, etc.) with the quantity in parentheses. For example, B(2) would be the second piece of attaching hardware that is listed, with a quantity of two at that point in the parts list. Table 7-3 contains a list of attaching hardware identifying each item by its letter code.

(4) Figure and Index Number. This column identifies the illustration and index number of the listed repair part.

7-2. LIST OF MANUFACTURERS. Table 7-4 contains a list of the manufacturers identified in the Name and Description column of table 7-2 by a five digit manufacturer's code. That code is an FSCM which is assigned in accordance with Cataloging Handbook, Federal Supply Code for Manufacturers, United States and Canada, H4-1. Codes listed in table 7-2 are cross-referenced to the manufacturer's name and address in table 7-4.

Table 7-2. Parts List

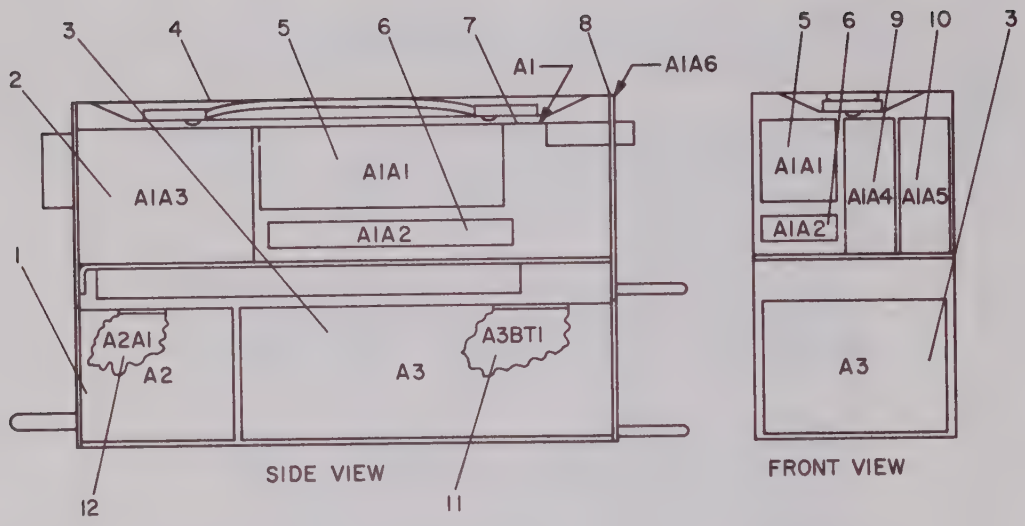
Reference Designation	Notes	Name and Description	Figure and Index Number
		FREQUENCY-TIME STANDARD AN/URQ-23: Provides 5 MHz and 1 MHz sine wave outputs, 100 KHz square wave output, and 1 PPS and 1 MPPS pulsed outputs with precise and stable frequencies and ability to lock phase and synchronize frequency to reference input; mfr 14844, part No. 11500-2800.	7-1
A1		OSCILLATOR, RADIO FREQEUNCY O-1783/URQ-23: Provides signal generating function and circuits for frequency synchronization, phase locking, and power control and distribution; mfr 14844, part No. 11520-2800.	7-1 (7)
A1A1		5MHZ OSCILLATOR: Provides voltage controlled oscillations at 5 MHz; mfr 14844, part No. D15530-2800. (Attaching parts) A(1), B(1), C(1), D(2), E(2), F(2)	7-1 (5)
A1A2		LOOP FILTER/OSCILLATOR TUNING: Provides filtering for frequency control loop and tuning circuits for 5 MHz oscillator A1A1: mfr 14844, part No. 11540-2800. (Attaching Parts) B(3), G(3), H(3)	7-1 (6)
A1A3		POWER CONVERTER: Provides dc-to-dc conversion to develop operating potentials for rf oscillator A1 circuits: mfr 14844, part No. 11550-2800.	7-1 (2)
A1A4		1PPS GENERATOR AND FREQUENCY CONTROL: Develops pulse outputs and contains frequency control, synchronization, and phase locking circuits for standard: mfr 14844, part No. 11570-2800.	7-1 (9)
A1A5		BUFFER/DIVIDER: Develops sine and square wave outputs of standard; mfr 14844, part No. 11590-2800.	7-1 (10)

Table 7-2. Parts List (Continued)

Reference Designation	Notes	Name and Description	Figure and Index Number
A1A6		FRONT PANEL: Houses or provides access to operating controls and indicators for standard; mfr 14844, part No. 11515-2800.	7-1 (8)
A2		POWER SUPPLY PP-7557/URQ-23: Develops raw dc potentials and charges batteries in battery power supply A3; mfr 14844, part No. 11620-2800.	7-1 (1)
A2A1		AC CONVERTER AND BATTERY CHARGER: Processes ac primary power and develops charging current for batteries; mfr 14844, part No. 11639-2800.	7-1 (12)
A3		BATTERY POWER SUPPLY BB-712/URQ-23: Provides source of emergency dc power; mfr 14844, part NO. 11610-2800.	7-1 (3)
A3BT1		BATTERY PACK, NICKEL CADMIUM: 12 volts; mfr 14844, part No. 122250-2800. (Each pack consists of 10 "F" size cells.)	7-1 (11)

Table 7-3. Attaching Hardware

Letter Code	Name and Description
A	SCREW, MACHINE, PAN HEAD, CROSS RECESSED, CRES: MS51975-27, No. 6-32
B	WASHER, FLAT, ROUND, CRES: MS15795-805, No. 6
C	WASHER, LOCK, SPLIT, CRES: MS35338-136, No. 6
D	NUT, HEX, PLAIN, CRES: MS35649-14, No. 4-40
E	WASHER, LOCK, SPLIT, CRES: MS35338-135, No. 4
F	WASHER, FLAT, ROUND, CRES: MS15795-803, No. 4
G	SCREW, MACHINE, PAN HEAD, CROSS RECESSED, CRES: MS51957-28, No. 6-32
H	WASHER, LOCK, SPLIT CRES: MS35338-136, No. 6



1. Power Supply Module A2
2. Power Converter Assembly A1A3
3. Battery Supply Module A3
4. Carrying Strap
5. 5MHz Oscillator Assembly A1A1
6. Loop Filter/Oscillator Tuning Assembly A1A2
7. RF Oscillator Module A1
8. Front Panel Assembly A1A6
9. 1 PPS Generator and Frequency Control Assembly A1A4
10. Buffer/Divider Assembly A1A5
11. Battery Pack
12. AC Converter and Battery Charger Assembly A2A1

Figure 7-1. Module and Assembly Location Diagram

Table 7-4. List of Manufacturers

Code	Name and Address
14844	Frequency Electronics, Inc. 3 Delaware Drive New Hyde Park, New York 11040

CHAPTER 8

INSTALLATION

8-1. INTRODUCTION. This chapter contains procedures and data necessary for site selection, installation, and installation checkout.

8-2. SITE INFORMATION. When selecting a site for installation of the standard, the following requirements for operation should be considered:

a. Temperatures should be between 0° C and 50° C, preferably constant.

b. Relative humidity should not exceed 95 percent.

c. Primary power requirement is 115 volts ac, 50-60 Hz ±5%, or 400 Hz ±10%, single phase. Dc power requirement of +22 to +30 volts is optional.

d. Cable lengths to and from the standard should be kept as short as possible.

e. Sufficient space should be allowed for operation and maintenance.

f. When selecting rack mounting for the AN/URQ-23, the following dimensional requirements should be considered:

(1) 18" front clearance for withdrawal of standard and disconnection of the rear cables

(2) 14" front clearance for withdrawal of front modules and disconnection of the cables while standard remains mounted

(3) 5 1/2" rear clearance for withdrawal of A2 power supply module while standard remains mounted

(4) 3" front and rear clearance for connectors and cable bends

g. Cables shall have an additional length of 24", minimum, to permit withdrawal of the standard and its modules.

h. Avoid mounting the AN/URQ-23 unit adjacent to:

(1) Heat generating equipment such as power supplies, motors, etc.

(2) Rf generating equipment such as relay banks, transmitters, choppers, etc.

(3) Equipment that transmits excessive vibration

i. Due to EMI/EMC considerations:

(1) Mount units in left side of rack if possible.

(2) Do not mount sensitive equipment directly beneath standard. Equipment operating in the 5 KHz to 25 KHz frequency range such as video/audio amplifiers, VLF receivers, electronic voltmeters, oscilloscopes, etc., should be located elsewhere.

8-3. REFERENCE PUBLICATION. The Technical Manual for RF Amplifier AM-2123A(V)/U, NAVSEA 0967-LP-225-9010 (with Change 1), should be referenced when that equipment is used with the standard.

8-4. TOOLS AND MATERIALS REQUIRED FOR INSTALLATION. Tools and materials required for installation are described in the following subparagraphs.

a. Tools. Tools required for installation are as follows:

(1) 1/4-inch electric drill and bits

(2) Phillips screwdriver No. 2

(3) Soldering iron, 25 watt, maximum, with 60/40 rosin core solder

b. Equipment and Materials. Equipment and materials required for installation, but not supplied with the standard, are as follows:

NOTE

An equipment carrier is available for simplified rack mounting of one, two, or three standards, abreast. The carrier is available from Frequency Electronics, Inc. (see table 7-4) as part number D6042-168.

(1) Straight Plug Connector M32122E-10-6P for external dc power and alarm

(2) Coaxial Plug Connector, Type BNC M39012/21-0001 (12 required) for connection of input and output signals

(3) Cable, Type 6SGU (quantity and length to be determined by installation requirements) for connection of external dc power and alarm signals

(4) Coaxial Cable, Type RG-58/U (12 lengths to be determined by installation requirements) for connection of input and output signals

(5) Screw, Machine, Pan Head, MS51957-45, 8-32UNC x 1/2 in. long, for mounting hardware (two required)

(6) Screw, Machine, Pan Head, MS51958-64, 10-32 UNF x 5/8 in. long, for mounting hardware (four required)

(7) Washer, Flat No. 8, MS15795-807, for mounting hardware (two required)

(8) Washer, Flat No. 10, MS15795-808, for mounting hardware (four required)

(9) Washer, Lock, Split No. 8, MS35338-137, for mounting hardware (four required)

(10) Washer, Lock, Split No. 10, MS35338-138, for mounting hardware (four required)

8-5. UNPACKING AND REPACKING. Unpacking and repacking procedures for the standard are described in the following subparagraphs.

a. Unpacking. Perform the following steps to unpack the standard:

(1) Be careful during the unpacking of the standard. Do not use sharp instruments that might penetrate the package and damage the standard.

(2) Check the contents of the package against the items listed on the packing list shipped with the standard.

(3) Thoroughly inspect the standard for any damage incurred during shipment.

b. Repacking. Repacking of the standard is essentially the same as packing for original shipment. Use the packing materials received with the standard if those materials have been retained. Before packing the standard for shipment, make certain that the ON/OFF switch at the rear of battery power supply A3 (figure 2-3) is in the OFF position, unless the total shipment time will not exceed 7 hours and the batteries in the standard are fully charged.

8-6. PREPARATION OF FOUNDATIONS. There is no foundation preparation required for the installation of the standard.

8-7. INPUT REQUIREMENTS. The input requirements for the standard are as follows:

a. Power. The standard requires a 115 volt ac power source of 50 or 60 Hz ±5% or 400 Hz ±10%, single phase. Dc power of +22 to +30 volt may or may not be supplied.

b. Ventilation. No special ventilation is required for the standard provided that ambient temperatures remain relatively constant between 0° and 50° C.

8-8. INSTALLATION PROCEDURES. Installation procedures consist of mounting and cabling procedures described in the following subparagraphs.

a. Installation Mounting. The standard can be bench mounted, rack mounted, or used in a free-standing arrangement. Figure 8-1 illustrates a typical application in which the standard is one of a group of bench-mounted units. Figure 8-2, the installation diagram for the standard, shows the location (in Detail B) of the mounting holes to be used for arrangements of this type. Mounting hardware for bench-mounting must be long enough to accommodate the thickness of the bench on

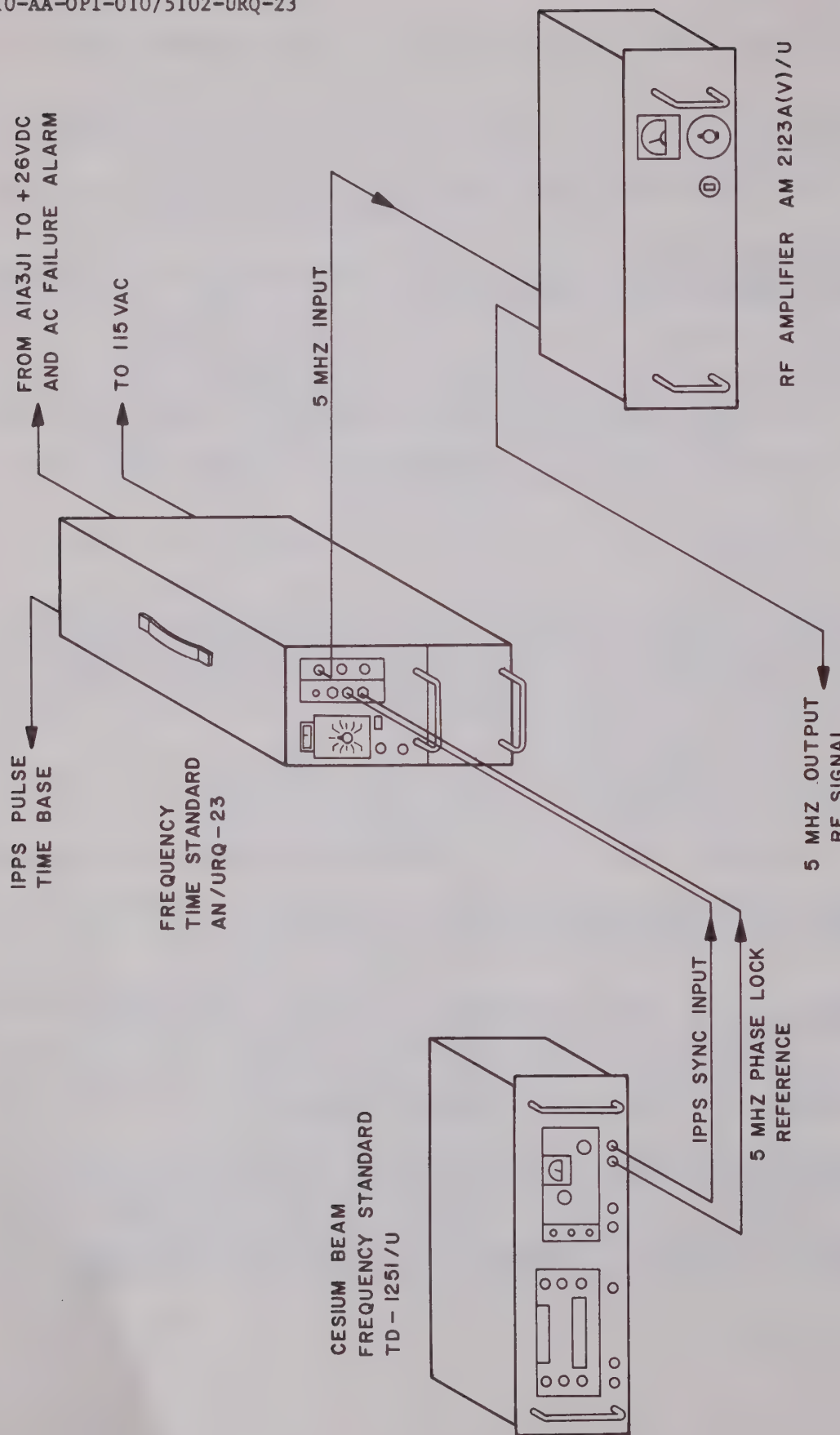


Figure 8-1. Typical System Application of Standard

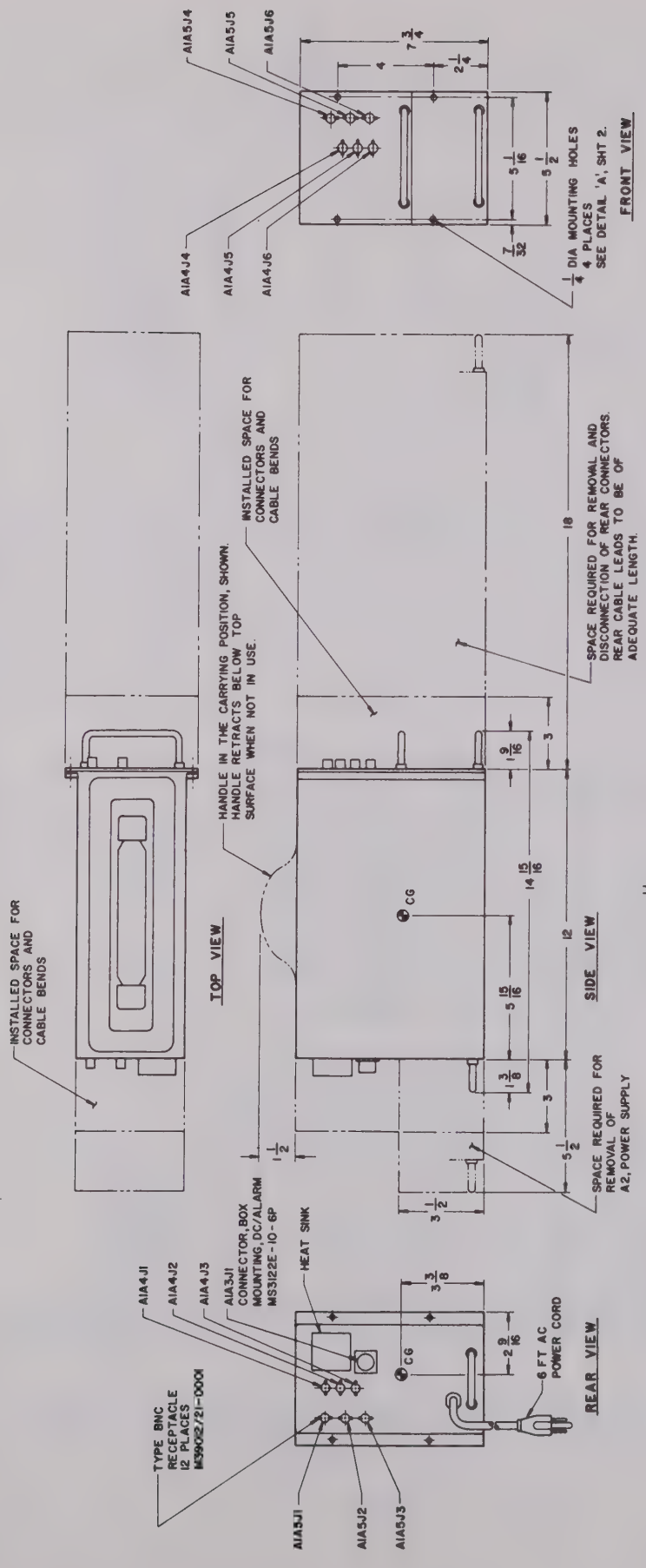


Figure 8-2. Installation Diagram (Sheet 1 of 2)

NOTE:

Refer to paragraph 8-2 for notes pertinent to the installation of the standard, and paragraph 8-4b for required mounting hardware.

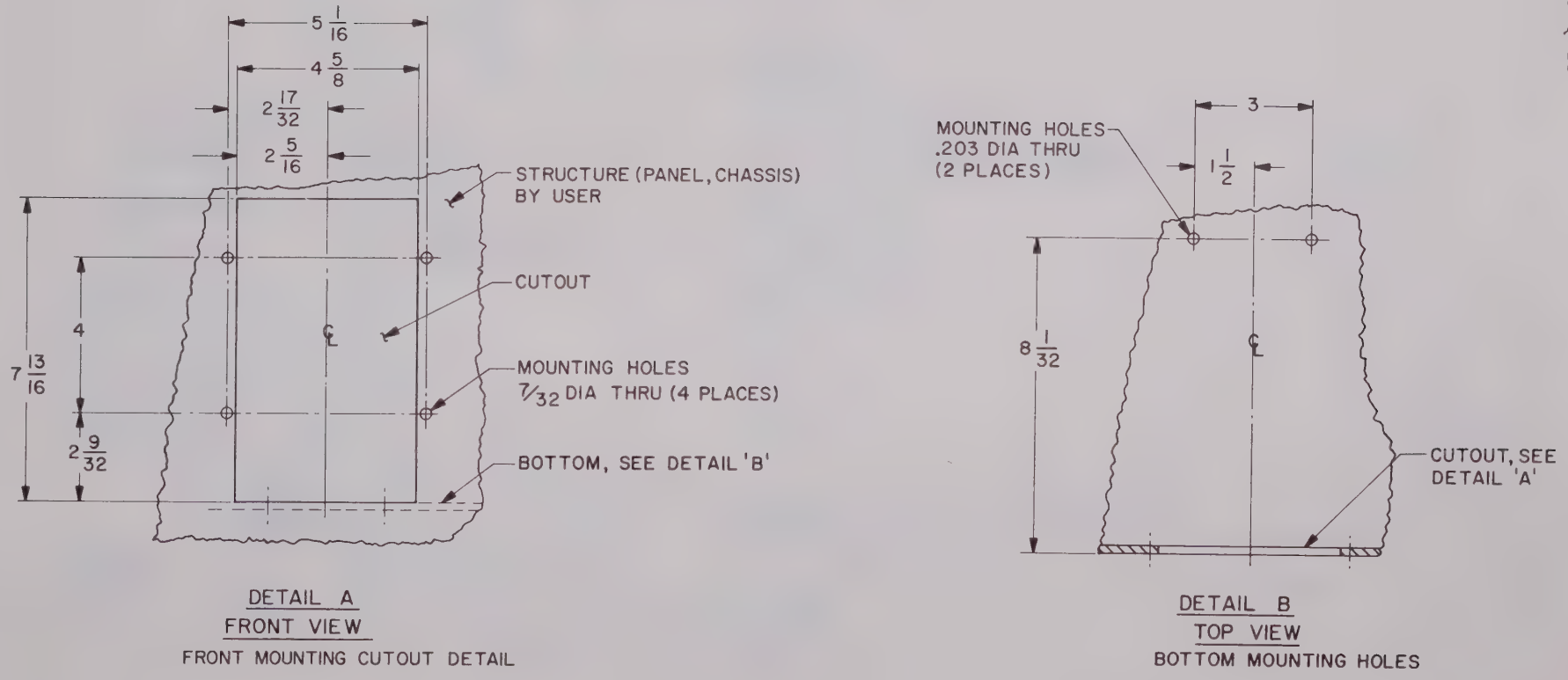


Figure 8-2. Installation Diagram (Sheet 2 of 2)

which the standard will be mounted. Holes in the front of the standard, and on the top, are used for panel mounting in an electrical rack. (See Detail A, figure 8-2, Sheet 2.) Specific mounting arrangements are shown in the following NAVELEX Installation Control Drawings, which are to be used when applicable:

(1) 25131-6842 - Drawing List

(2) 25132-6842 - Block Diagram

(3) 25133-6842 - Cable Running Sheets

(4) 25134-6842 - Summary List of Installation Material

(5) 25135-6842 - Input/Output Sheet

(6) 25136-6842 - Outline & Installation Drawings

b. Electrical Cabling. Electrical cabling data for the standard is shown in figure 8-3 as a typical installation arrangement. When making any electrical cabling arrangement for the standard, keep cable lengths as short as possible. Use the connector and cable types listed in subparagraph 8-4b when fabricating cables. If more than one standard is to be connected (ie. mounted abreast of each other), an optional equipment carrier is available as noted on page 8-2. The ac line cord supplied with the standard is a three-terminal ac power plug with one terminal grounded. No other special grounding or bonding procedures are required. Refer to table 8-1 when making cable connections to signal and power terminations.

8-9. INSTALLATION CHECKOUT. When installation has been completed, proper operation must be verified before placing the standard into service. Installation checkout is performed in three phases. Phase 1 consists of inspection procedures performed before the standard is turned on; phase 2 consists of turn-on and preliminary tests performed when the standard is turned on for the first time; and phase 3 consists of checks made during initial operation.

a. Phase 1 - Installation Inspection and Pre-Engergizing Procedures. Upon completion of the installation procedures, perform the following checks:

(1) Check that all mounting hardware is firmly secured.

(2) Check that all electrical cabling connections are correctly made and electrical connectors are secured.

(3) Place the CIRCUIT CHECK switch on the front of the standard to the DC IN position and make certain that the CIRCUIT CHECK meter reads 0.

(4) Make certain that the front and rear of the standard are easily accessible for maintenance purposes.

b. Phase 2 - Turn-On and Preliminary Test. After completion of the Installation Inspection & Pre-Energizing Procedures, perform the Preliminary Setup portion of table 2-2.

c. Phase 3 - Operational Tests. After completion of the Turn-On and Preliminary Test, perform the Verification Test described in paragraph 4-9.

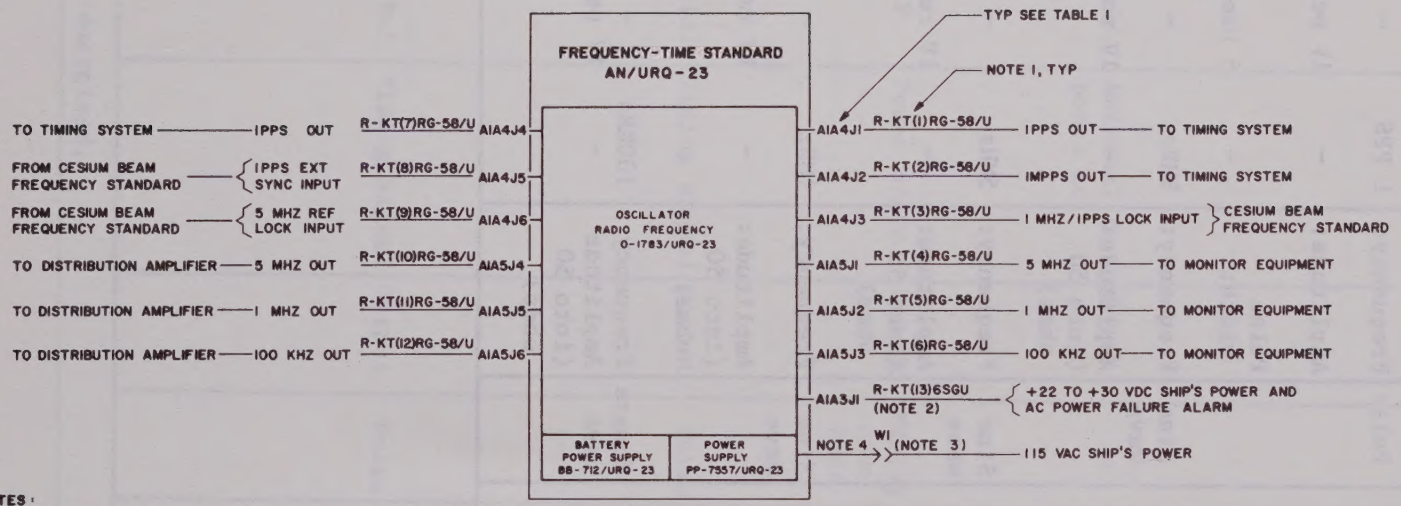
Table 8-1. Signal and Power Data

Plug or Jack	Terminal	Function	Input/ Output	Type	Signal Parameter	Characteristics		
						Nominal	Minimum	Maximum
Ac line cord plug	N/A	External ac power in	Input	Ac	Amplitude:	115V	103.5V	126.5V
					Frequency:	50Hz 60Hz 400Hz	47.5Hz 57Hz 360Hz	52.5Hz 63Hz 440Hz
					Power:	18W	18W	30W
					Phase:		Single	
					Power Factor:	0.87	-	-
A1A3J1	A,B,C	External dc power in	Input	Dc	Amplitude:	+26V	+22V	+30V
					Power:	-	-	30W
					Power Factor:	0.87	-	-
A1A3J1	D,E,F	Power alarm	Output	*Relay contact	Alarm relay:	D-E open, E-F closed	-	-
A1A4J1 and A1A4J4	Coaxial	Timing signal	Output	Pulse	Frequency:	1 PPS	-	-
					Amplitude: (into 50 ohms)	4.7V	4.2V (peak)	5.2V
					Pulse width: (µsec)	20	18	22
A1A4J2	Coaxial	Timing signal	Output	Pulse	Frequency:	1 MPPS	-	-
					Amplitude: (into 1K ohm)	1.2V rms	1.1V rms	1.3V rms
					Pulse width: (µsec)	0.8	-	0.8

*Relays are energized.

Table 8-1. Signal and Power Data (Continued)

Plug or Jack	Terminal	Function	Input/ Output	Type	Signal Parameter	Characteristics		
						Nominal	Minimum	Maximum
A1A4J3	Coaxial	Timing signal	Input	Rf & pulse	Frequency:	1 MHz/ 1 PPS	-	-
A1A4J5	Coaxial	Synchroniza-tion input	Input	Pulse	Frequency:	1 PPS	-	-
					Amplitude:	-	1V peak	-
					Pulse width:	-	5 µsec	-
A1A4J6	Coaxial	Phase lock reference input	Input	Sine wave	Frequency:	5MHz	-	-
					Amplitude: (into 50 ohms)	-	1V rms	-
A1A5J1 and A1A5J4	Coaxial	Rf signal	Output	Sine wave	Frequency:	5MHz	-	-
					Amplitude: (into 50 ohms)	-	1V rms	-
A1A5J2 and A1A5J5	Coaxial	Rf signal	Output	Sine wave	Frequency:	1MHz	-	-
					Amplitude: (into 50 ohms)	-	1V rms	-
A1A5J3 and A1A5J6	Coaxial	Rf signal	Output	Square wave	Frequency	100KHz	-	-
					Amplitude (into 50 ohms)	-	1V peak	-


FREQUENCY-TIME STANDARD
AN/URQ-23
TYP SEE TABLE I
NOTE 1, TYP
OSCILLATOR
RADIO FREQUENCY
O-1783/URQ-23
BATTERY
POWER SUPPLY
88-712/URQ-23
POWER
SUPPLY
PP-7557/URQ-23
TO TIMING SYSTEM — 1PPS OUT — R-KT(7)RG-58/U — A1A4J4
FROM CESIUM BEAM FREQUENCY STANDARD — 1PPS EXT SYNC INPUT — R-KT(8)RG-58/U — A1A4J5
FROM CESIUM BEAM FREQUENCY STANDARD — 5 MHZ REF LOCK INPUT — R-KT(9)RG-58/U — A1A4J6
TO DISTRIBUTION AMPLIFIER — 5 MHZ OUT — R-KT(10)RG-58/U — A1A5J4
TO DISTRIBUTION AMPLIFIER — 1 MHZ OUT — R-KT(11)RG-58/U — A1A5J5
TO DISTRIBUTION AMPLIFIER — 100 KHZ OUT — R-KT(12)RG-58/U — A1A5J6
A1A4J1 — R-KT(1)RG-58/U — 1PPS OUT — TO TIMING SYSTEM
A1A4J2 — R-KT(2)RG-58/U — 1MPPS OUT — TO TIMING SYSTEM
A1A4J3 — R-KT(3)RG-58/U — 1 MHZ/1PPS LOCK INPUT — CESIUM BEAM FREQUENCY STANDARD
A1A5J1 — R-KT(4)RG-58/U — 5 MHZ OUT — TO MONITOR EQUIPMENT
A1A5J2 — R-KT(5)RG-58/U — 1 MHZ OUT — TO MONITOR EQUIPMENT
A1A5J3 — R-KT(6)RG-58/U — 100 KHZ OUT — TO MONITOR EQUIPMENT
A1A3J1 — R-KT(13)6SGU (NOTE 2) — +22 TO +30 VDC SHIP'S POWER AND AC POWER FAILURE ALARM
NOTE 4 — W1 (NOTE 3) — 115 VAC SHIP'S POWER

NOTES:

1. THE NUMBER SHOWN IN THE PARENTHESIS OF THE CABLE NUMBER [R-KT( )] IS FOR REFERENCE ONLY. THE INSTALLING ACTIVITY IS TO ASSIGN THE ACTUAL NUMBERS.
2. THE INSTALLING ACTIVITY IS TO ASSIGN NAVY CABLE DESIGNATIONS TO THE POWER AND POWER/ALARM CABLES.
3. THE POWER REQUIREMENT FOR THIS EQUIPMENT FOR THE INPUT FROM AC SHIP'S POWER IS:
   A. TYPE 1 AS DEFINED IN SECTION 103 OF MIL-STD-1399.
   B. NUMBER OF PHASES; ONE.
   C. FREQUENCY; 50 HZ ±5%; 60 HZ ±5%; 400 HZ ±5%.
   D. VOLTAGE; 115 VOLTS, ±10%.
   E. POWER FACTOR; 0.87.
   F. LINE CURRENT, OPERATING; 140 MA.
   G. LINE CURRENT, STARTING; 250 MA.
   H. MAXIMUM OPERATING POWER; 30 WATTS.
   I. STANDBY CONDITION POWER; 18 WATTS.
   J. SECURE CONDITION POWER; 18 WATTS.
4. THE EXISTING 6 FOOT LONG POWER CORD WITH TYPE D PLUG PER FED SPEC W-C-596 IS AN INTEGRAL PART OF POWER SUPPLY PP-7557/URQ-23.

TABLE I
CONNECTOR IDENTIFICATION

JACK NUMBER	CONNECTOR TYPE	PIN FUNCTION	
A1A4, J1 THRU J6 INCL	BNC	SIGNAL	
A1A5, J1 THRU J6 INCL	BNC	SIGNAL	
A1A3J1	MS3122E-10-6P	EXT DC INPUT	EXT ALARM (RELAY CONTACTS)
		PIN A +22 TO +30VDC	PIN D NORMALLY OPEN
		PIN B GND, DC RTN	PIN E RELAY ARM
		PIN C GND, DC RTN	PIN F NORMALLY CLOSED

Figure 8-3. Cabling Diagram